An Integrated Learning Curriculum for Radiography

in

South Africa

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Dedication

To Nicola and Colin, to my parents, family and friends. This is for all of you.

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ABSTRACT

The most significant changes and challenges to radiography in South Africa are rapid technological changes in the fields of imaging and radiation oncology, the changing status of radiographers as members of the multi-disciplinary health care team and the socio-economic impact of post-apartheid ideology, policy and legislation with regard to both higher education and health provision. This altered landscape in which academic and clinical work is accomplished has impacted on radiography education. Curricula must change in order to equip graduates to work effectively in the modern workplace and the Integrated Learning Curriculum (ILC) is one such curriculum response. The traditional radiography curriculum of connecting subject-based theory education with interspersed clinical experience where there is reliance on students connecting or applying the subject content taught in the classroom to clinical practice was challenged. The ILC planned to enhance the integration of teaching, learning and assessment in the academy and workplace in a transforming South Africa. This study took advantage of the opportunity to capture data and learning from this curriculum renewal.

The research was guided by the questions: 1) What is the nature of radiographic knowledge? 2) What curricular options would facilitate radiographic knowledge? 3) What would enable or constrain successful curriculum implementation? 4) Is the ILC an appropriate curriculum for Radiography? This study facilitated a 'layered' understanding of integration and integrated curriculum through exploration of the concept 'integration'. This was achieved through; a national survey that investigated opinion on the status of radiography education in South Africa in 2003; interpretation of the context within which the ILC was located; a search of relevant literature; and a case study that gathered data over a three-year period.

Findings support the notion that the workplace is a key influence on higher education curricula and that an integrated learning curriculum suits radiography. This requires a structural partnership between the higher education institution (academy) and the clinical radiographic facilities (context of application, workplace or world of work). However, it is the individuals with their working relationship of shared responsibility that are essential to

ensuring well-equipped graduate practitioners for the radiography profession. Curriculum integration promotes an emphasis on learning and knowledge. Subject specialists must move beyond established 'boundaries' to accommodate a learning areas focus. This forces pedagogical changes and the integration of generic competencies that enhance the acquisition of skills to allow self-directed learning and the life long retention of professional currency.

Due to the variety of understandings of integrated curriculum this research addressed two components, firstly, concerning the goal and definition of ILC, and secondly, the structure of ILC. The outcome is a final chapter that integrates knowledge from the research componenet to present an understanding of an integrated curriculum. Curriculum is presented as a process with recognition of the existence of mobile, self-selected academic roles and an identity or culture within the clinical environment. A framework for an integrated curriculum addresses the issues of; what is integrated, a continuum of integration, a typology and structure of an integrated curriculum, components of the ILC and criteria for an integrated curriculum.

The study being specific to an integrated curriculum in radiography in South Africa is the first such research within this context. It therefore has the potential to provide a basis for further research on other aspects of curriculum and integrated learning in radiography. There is potential benefit to radiography in other contexts and to all health science programmes. The findings may even contribute to higher education, within the professional education arena, beyond the limits of health science.

ACRONYMS AND ABBREVIATIONS

ANC	African National Congress
PBL	Problem Based Learning
CCFO	Critical Cross Field Outcome
CPUT	Cape Peninsula University of Technology
HPCSA	Health Professions Council of South Africa
IAEA	International Atomic Energy Agency
ILC	Integrated Learning Curriculum
NQF	National Qualifications Framework
NSB	National Standards Body
OBE	Outcomes Based Education
SAQA	South African Qualifications Authority
SGB	Standards Generating Body
WIFO	Wissenschaftsforum Bildung und Gesellschaft

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1. A curricular response to contextual change

> All around the world, higher education is expanding rapidly, governments are mounting inquiries into higher education, more institutions are involved in running courses of study and more money is being spent on higher education, not least by students themselves. Higher education is ever more important to increasing numbers of people. And yet, despite all this growth and debate, there is very little talk about the curriculum. What students should be experiencing is barely a topic for debate. What the building blocks of their courses might be and how they should be put together are even more absent from the general discussion. The very idea of curriculum is pretty well missing altogether (Barnett & Coate, 2005: 1).

1.1 Introduction

There is much debate around 'outcomes', 'skills', 'benchmarks', 'programmes', 'standards', 'quality', and 'teaching and learning strategies' in higher education, but studies of higher education curricula are so infrequent that Barnett and Coate (2005: 13) call it 'a missing term', which amounts to a reluctance among researchers and theorists to engage seriously with the knowledge base of higher education. Young (2005: 10), for example, distinguishes curriculum studies as being concerned with '(formal) knowledge', while Muller (2003: 104) understands the field as addressing disciplinary 'knowledge configuration and change'. Others are less definitive in their understanding of curriculum studies, and do not distinguish as clearly between the knowledge structure and its associated pedagogies (Ramsden, 1992; Biggs, 2003). This thesis attempts to engage with debates in the field of curriculum studies, through the detailed examination of a particular curriculum innovation in Radiography.

Challenges to the curriculum come from both exogenous (socio-economic, political, contextual, institutional) and endogenous (internal to the knowledge structure of the discipline or field) sources (Sim, Zadnik & Radloff, 2003). The 'discipline' of Radiography has experienced both exogenous and endogenous changes and challenges. These have involved academics and practitioners in an interrogation of the role and purpose of health provision in South Africa generally, and the place of radiography in the transformation of health care more specifically. Rapid technological changes in the fields of imaging and radiation oncology have reconfigured the knowledge base of radiography, and these changes have associated pedagogical approaches: they require radiographers to become life long learners. Changes to the professional context have positioned radiographers as important members of the multidisciplinary health care team.

Post-apartheid ideology, policy, and legislation – with regard to both higher education and health provision – have fundamentally altered the landscape in which academic and clinical work is accomplished. The social transformation of higher education has led to an increasingly diverse community of students. The social transformation of state hospitals has resulted in a linguistically and culturally diverse patient population at all levels of health care. This is a marked change from the time when many people in South Africa did not have access to even primary health care and hospitals served segregated populations.

These disciplinary, technological, professional, and social changes have had an impact on the shape and structure of radiography curricula. These too must change in order to equip graduates to work effectively with new knowledge in different technological, professional and social contexts. However such a responsive curriculum, while responding to change, does not directly address particular needs. Also there will be some changes unique to the context of any curriculum but many of the changes will be globally relevant to radiographers in all countries. Hence while this study focused on a particular curricular response in South Africa it will have compatibility with health science curricula in other places and is therefore a project with potentially worldwide impact.

This chapter broadly examines the contexts affecting radiographic practice in 21st century South Africa, many of which hold for other countries as well. An argument is presented for a particular curricular response to these changes and the research study is introduced.

1.2 Changing technical, professional, and social contexts

In the simpler world of the past, students could be prepared for the known. A relatively static, content-based syllabus was adequate to guide training. The qualified person could steadily adapt to a slowly changing environment. This is no longer the case, and in the light of rapid contextual change there are many challenges to preparing students for an increasingly complex and uncertain world (Barnett, 2004). This section presents an overview of some of the main contextual issues affecting radiography.

1.2.1 The global context

Knowledge-based technologies have accelerated the production of knowledge in what is variously known as the 'Network Age' (Castells, 2000) or the 'Knowledge Economy' (Neef, 2004). Knowledge-based technologies have had profound effects on the technological, professional and social contexts in which radiography is practised.

Globalisation and technology

Radiography came into existence with the discovery of x-rays, just over a century ago. Since then there has been considerable development in the field. Hospital-based training met the needs of the vocation for many years. Recently the rapidly increasing knowledge and competency requirement and professionalisation of radiography has resulted in higher education qualifications, including degrees, in many countries. At the global level, the main contextual challenges to are technological developments, and their applications, in the field of radiographic imaging and radiation oncology. Standard x-ray equipment was used for imaging for decades. Now modalities such as ultrasound, computer tomography and magnetic resonance are routinely used. In radiation oncology the equipment for external beam therapy and brachytherapy develops constantly. The use of high technology mechanisms such as multi-leaf collimation and virtual wedges are fast becoming the norm. Technology has changed the daily practice of the radiographer.

Globalisation and the workplace

Advanced technologies require new organisational and management practices (Drucker, 2001; Recklies, 2003), and require workers to develop new knowledge, skills and attitudes (Senge, 1992). A feature of the 'knowledge economy' is that workplaces have become knowledge production sites (Chappell, 2000). This new structure requires workers to be flexible, adaptable, and to share decision-making in flatter organisations, with less pronounced hierarchies. In such a structure, interconnections or networks between companies, regions and even countries are emphasised (Castells, 2000). There is an increasing need for teamwork and the building of networks on many levels across many disciplines (Cys, 2000).

Rapid, relentless technological developments, and their associated information networks, have impacted heavily on hospitals and higher education institutions (Castells, 2000). In particular, hierarchical stability has been challenged. The rapid technological development in radiation medicine has changed the status of the clinical radiographer. This has created new professional contexts in which radiographers are partners in the integrated care of patients through multidisciplinary health care teams.

Radiography can no longer depend on the knowledge and skills base developed by non-radiographers. Radiography as an emerging profession must take responsibility for developing the knowledge base that is specific to radiography.

Globalisation and Higher Education

Educational reform is increasingly influenced by economic and social change (Carnoy & Rhoten, 2002). Higher education, which has traditionally resisted change, is in a process of developing strategies around inclusiveness and responsiveness to social needs (Odora Hoppers, 2002). An emerging regime of 'strategic science' (Rip, 2003a), particularly in technical disciplines, offers innovative knowledge that is problem-based and is distributed across actors and institutions, including others beyond the scientific world. As disciplinary boundaries become less defined, the development of useful knowledge by multidisciplinary teams in the context of application (Gibbons *et al.,* 1994; Nowotny, Scott & Gibbons, 2001) must be balanced against the loss of deep knowledge in a single discipline. Radiographers therefore need to become, as Castells (2000) puts it, 'self-programmable'. They need to develop the ability to adapt and learn new knowledge as they redefine themselves to meet the demands of the changing workplace.

Globalisation and South Africa

The government of the new democratic South Africa has had to redress the legacy of Apartheid and, at the same time, face the challenge of economic competitiveness in a rapidly changing global environment. The first decade of democracy in South Africa has seen macro-economic policies designed to further the global positioning of the country (GCIS, 2003).

I turn now to consider in more detail, the relationship between the production of knowledge and the transformation of South African society.

1.2.2 National, Regional and Local Context

National, regional and local contexts in a developing, transforming South Africa are influenced by global pressures (Boland, 2000). This has created a tension between the reduced public expenditure on education, the need for higher education to be accessible to a diverse student community, and the demand for economic growth that requires ever-increasing education levels for the workplace (Carnoy & Rhoten, 2002).

Socio-political economic agenda

After the first democratic elections in 1994, the African National Congress (ANC) became the governing party with a mandate to redress existing inequities and inequalities (Weber, 2001). Macro-level policies such as the policy for Growth, Equity and Reconstruction and the Reconstruction and Development Programme underpinned all transformation processes (Odora Hoppers, 2002). The introduction of new policies, consistent with the democratic constitution (GCIS, 2003), included the transformation of health care and higher education to meet the goals of equity, equality and social justice.

South Africa is a developing country with pockets of advanced technology and economic development, which makes it one of the most unequal societies in the world. There is thus a constant tension between desire for global competitiveness and the needs of development. The census of 2001 records a population of 44,8 million people, a 10% growth from the 1996 census. It reports that one in three people over the age of 19 years has had no schooling, or incomplete primary education. Fewer than 10% of households have a computer with a marked difference between population groups: less than 2% of black-headed households have a computer in contrast with 46% of white-headed households. The majority of the population (89%) of the Western Cape (where the research study is based) live in urban areas, differing significantly from the national average of 54%. The health care system of the Western Cape functions relatively well with an infant mortality rate of 26,9 per 1000 live births, which is significantly lower than the national figure of 45,4 (Statistics South Africa, 2001).

Education

Education in South Africa was central to the apartheid policies. This made race central to curriculum (McCarthy, 1990). Education departments were segregated according to the race classification of the country. The Bantu Education Act, Act No. 47 of 1953, established a Black Education Department in the Department of Native Affairs that delimited and restricted the education of black South Africans (Department of Native Affairs, 1953). It aimed to maintain a labour force and prevent Black South Africans from being educated at a level that would make them aspire to positions that they were not permitted to hold. To further entrench this, the Extension of University Education Act, Act 45 of 1959 (Department of Education, 1959), stopped black students attending white universities and created separate tertiary institutions for white, coloured, black and Asian students (Boddy-Evans, 2004). The negative impact of apartheid on education was worsened by the lingering effect of colonialism: a legacy of disempowerment, disenfranchisement, and the devaluing of knowledge and knowledge systems that develop beyond the confines of Western science (Odora Hoppers, 2002). By 1994, there was clearly a need to overcome the rigidities and inequalities inherited from the past in order to meet the dual challenge of social development and global competitiveness.

The Department of Education of post-apartheid South Africa moved quickly into a revision and restructuring of the education system as evidenced in the South African Qualifications Authority (SAQA) Act No. 58 of 1995, and the Higher Education Act, Act No. 101 of 1997. A National Qualifications Framework (NQF) was developed, which included a strong commitment to Outcomes Based Education (OBE), and which was influenced by similar qualifications frameworks in Europe, Australasia and North America. The SAQA Act No. 58 of 1995, provided for the establishment of SAQA as a mechanism with multiple tasks: to integrate the education and training systems; facilitate access, mobility and progression; enhance quality; accelerate redress; and contribute to the personal development of individual learners and the social and economic development of the country (SAQA, 2000). It would achieve this by accrediting programmes, by developing a national framework to ensure that qualifications promote an integrated OBE approach to education and training and by recording learner credits. The NQF together with a unified education and training system were important for addressing human resource development:

> The aim of integrating education and training based on a single national qualification system that will build human resource capacity for economic growth in line with Western modernity and recent changes in the global economy... (Weber, 2002: 279).

OBE aimed at providing equal and adequate education opportunities to all South Africans, and developing thinking, problem-solving citizens to ensure that individuals were empowered to participate in the development of the country in an active and productive way (SAQA, 2000). It was believed that OBE would generate new curricula that cut across the traditional separation of skills and academic knowledge through being learner centred and based on the evaluation of the learner's applied competence to transfer the knowledge and skills. The principles of OBE in South Africa intended to ensure that all students were provided with opportunities to learn to their full potential. All learners should have a high expectation of success and there should be no stereotyping of students according to race, gender or social background (Van der Horst & McDonald, 1997). The NQF provides a ten-level framework. Level 1 accommodates Adult Basic Education and Training certification levels as well as the General Education and Training Certificate. Levels 2-4 are the Further Education and Training levels and Level 5-10 is for Higher Education and Training (SAQA, 2000). The intention of the NQF points to an educational system whereby all learners can achieve nationally recognized and internationally comparable qualifications, and where each standard and qualification that adheres to the requirements of the NQF will be registered by SAQA (Du Pré, 2000).

SAQA grouped all areas of work and learning into twelve fields. Field 09 covers Health Sciences and Social Services (SAQA, 2000). Each field has a National Standards Body (NSB) that identifies sub-fields associated with the overarching field. Standards Generating Bodies (SGB), monitored by the NSB, develop qualifications within the sub-fields and ensure that the requirements of the qualification authority are met (Du Pré, 2000). In the absence of an SGB for radiography, the profession participated in the process of interim registration with SAQA through a national process of collaboration involving all higher education institutions offering radiography. Wide consultation was sought with employers, students, the professional association for radiography and the Professional Board for Radiography and Clinical Technology, the latter is a board of the Health

Professions Council of South Africa (HPCSA). In 2000, a programme specifying exit level outcomes was registered with SAQA for all radiography categories, along with thousands of other programmes from the higher education community. There is now a legislated structure, whereby the Professional Board for Radiography and Clinical Technology will function as the SGB. This standards body, through working groups, has responsibility for reviewing the qualification outcomes and career pathway for the submission of revised qualification documents to SAQA by June 2006.

The transformation of South African higher education means that the leaders of higher education institutions are under intense pressure to manage increasingly diverse and complex organisations in a competitive environment. Higher education institutions in South Africa are not only locally competitive, but have to become much more aware of regional and global competition. There is also large-scale expansion of private sector higher education in South Africa. At the same time there are calls to become more accountable for the public money allocation to higher education, which has resulted in a drive to utilise regional and national resources more efficiently through regional collaboration and institutional mergers of state institutions. Survival through collaboration has extended partnerships with a wide representation of institutions and organisations (Monkman & Baird, 2002) that includes partnerships for activities such as service learning, work experience, funding and research initiatives. Voluntary collaboration and mergers were inadequate to satisfy the national imperatives, so a national plan to restructure higher education for the democratic South Africa was implemented that resulted in the forced mergers of institutions. This unsettled environment has, amongst other things, created internal drives to reconfigure institutions and programmes to be more responsive to a rapidly changing external environment.

The national agenda, while driven by South Africa's particular reconstruction and development needs, is largely in alignment with higher education internationally.

This includes educational drivers such as the motivation for the development of learning institutions (Malhotra, 1996). However, the transformation of the leadership to new governance structures with distributed authority, the empowerment of others and the valuing of diversity is slow. Higher education institutions in general maintain their hierarchical structures with centralised authority. Moving from telling, directing and controlling to questioning, negotiating, and influencing is not easy. The transformation of higher education institutions into strong, growing, learning institutions with justice and equity can only occur if there is leadership at all levels (Senge, 1996). Here the leader is designer, teacher and co-facilitator of shared vision; and the building of institutions is through all members developing and designing their own future (Malhotra, 1996).

Health care in South Africa

The National Health Bill recognises the imbalance of health services and the need for ethical distribution of scarce resources to establish a society based on social justice and human rights where all people of this country have access to available health care (Department of Health, 2002a). Tertiary hospitals have high-level specialised health care and a full range of service departments with some of the latest technology. While it can be argued that they are indispensable to holistic, patient centred care, much of the health care needs of any community can best be managed in community-based facilities. However, there must be a well-managed referral system so that those in need can access secondary hospitals where there are some medical specialists and more advanced diagnostic facilities. Referral must again take place from secondary level to tertiary hospitals to formulate a well-structured health care system that appropriately serves the needs of the population at all levels of care. Since democracy in 1994 South Africa has focussed on the provision of primary health care for previously excluded communities (Department of Health, 2002a). This has meant a diminishing budget for tertiary care. Global shifts have shown similar transitions in other countries, though from different socio-political stances. Thus even in the well structured and well funded State Health Care system of Finland there is political pressure to encourage an increased use of primary care facilities rather than continue the unnecessary use of high cost tertiary care (Engeström, 2001).

Regionally, changes to ensure the devolution of services from tertiary to primary health care started after the first democratic elections, and will be furthered through the Vision 2010 plan of the Director-General for Health in the Western Cape. The plan proposes that 90% of patients should attend primary health care clinics, 8% secondary facilities, and only 2% of patients be referred for tertiary level care (Thom, 2004). This goal has to be achieved in a climate of more equitable distribution of resources among provinces, which means that the conditional grant funding to the Western Cape has decreased from 23,9% to 18,5% (Thom, 2004). The reduction in expenditure on tertiary level hospitals, which are the traditional sites for the clinical education of health science students, including radiography, is inevitable in this restructuring.

Another key aspect of the regional health environment is the expansion of high standard private health care. Through negotiation, students have benefited from the opportunity to do some of their in-service training in private facilities, and thereby gain experience on state-of-the-art equipment. There is an emerging interest in training at the private facilities in the Western Cape, years after other provinces in the country have established co-operation for radiography education in private health care.

After ten years of democracy, these changes in the structure of health care have resulted in many successes. Examples of these are: a unified system for health care delivery; wider access to health care; expanded access to primary care that contributes to the broad programme of poverty eradication; the deracialising of health care facilities; and expansion of collaborative partnerships between public, private and non-governmental sectors. Still, there are many challenges for the health service, and probably the most significant of these are access to health care, and the poor distribution of health care practitioners between public and private sector and between the urban and rural areas. The least developed parts of the country remain under-resourced, as health care professionals are not attracted to these areas. Equitable distribution through the rationalisation of health services is a task that is in progress (Department of Health, 2003).

The National Health Bill documents one of the functions of the national health department as the promotion of adherence to norms and standards for the training of health care practitioners (Department of Health, 2002a). In her budget speech of 2003, the Minister of Health, Dr Manto Tshabalala-Msimang, addressed the importance of skilled human resources for quality of service. She acknowledged that academic institutions build leaders in the health science professions (Department of Health, 2003), and confirmed the commitment of the government to quality health service that includes the higher education of health practitioners. The health and education departments are promoting the transformation of health science faculties in the bid for a greater contribution to the development of the country through diversity of the student body, and through a curriculum that addresses the health requirements of South Africa (Thom & Cullinan, 2001).

South African Health Science Education

Redress has been one of the most important ideals of the transformation process (National Education Co-ordinating Committee, 1993). The Department of Education's White Paper (1995), is a key document that, amongst other issues, recommends increased access to education and training and ways to enhance life long learning. The intention of Education Reform in South Africa is 'curricular justice' (Connell, 1994), whereby forms of knowledge, other than those sanctioned by traditional scientific disciplines, are valued (Odora Hoppers, 2002).

Curriculum change in health science programmes in South Africa builds on a reputation of world-class excellence. All Health Science/Medical faculties have embarked on curriculum reform to address the health needs in South Africa, as well as current thinking in medical education. The focus of the reform has been on a learning environment that incorporates elements of problem-based learning (PBL). The intention is to prepare the practitioner for national and global changes in health care, promote the primary health care approach, provide a solution to the shortage of health care professionals in rural South Africa and to develop respect and understanding of the interdisciplinary health care team. There is a more lenient approach to entry criteria in order to attract students that reflect the demography of the country, while stringent exit criteria are maintained and quality is not compromised (South African Association of Health Educationalists, 2003). The reform process has responded to the transformation and development agenda to address the complexities of a curriculum that educates more caring practitioners who are comfortable in rural clinics and specialised hospitals. They must meet the needs of the multi-tiered health care system that caters for, and is representative of, the South African population. Practitioners are expected to be self-directed learners, appreciate their surroundings, identify with the social circumstances of their patients, understand the primary health care approach underpinning their practice, develop interpersonal and counselling skills, and promote holistic care (Thom & Cullinan, 2001).

Radiography Education in South Africa

In South Africa, the radiography diploma was structured in the traditional way: lecture-based theory with simultaneous immersion in real-world clinical practice. However, the national demands for transformation and student-centred, relevant health care education and the global pressure for holistic health care practitioners, who have broader skills without the loss of competence in their profession, has made curriculum renewal an imperative (Department of Health, 2002a).

Worldwide higher education is changing, including radiography education, largely in response to external pressures and demands (Payne and Nixon, 2001). It is now pertinent to question whether the continuation of subject-based theory teaching, interspersed clinical training through work experience, is the educational model that best serves the needs and aspirations of the student, employer, patient and profession.

To position the research of curriculum renewal in radiography in South Africa, some of the key changes will be sketched. National examinations for a National Diploma issued by the Department of Education, or one of the three education departments of the apartheid system, changed when legislation forced the higher education institutions to take responsibility for the education of radiographers in the late 1980s, whereupon evaluation became an institutional function. More recently there has been the external drive for change in higher education institutions, due to the SAQA Act No. 58 of 1995 and the Higher Education Act No. 101 of 1997, as academic courses had to be planned and delivered according to the principles of programmes and OBE. Many radiography educators in South Africa recognised that curriculum renewal was necessary and, because of their location, this took place within existing higher education institutions with particular curricular traditions, many of which have a tendency to hamper innovation and change (Reser, 2000). Curricular shifts therefore varied from institution to institution as a result of local and regional contexts. For some the changes were marked, as it was realised that the traditional curriculum offered little flexibility for introducing the bold changes needed to respond to the transformation of health care in South Africa.

Locally, curriculum renewal lead to a registered OBE programme intended as a curriculum framework which could incorporate innovative educational approaches, included significantly revised content, interdisciplinary (Klein, 1997), teaching and learning, as well as maintaining the depth of knowledge required in each radiography category (diagnostic, nuclear medicine, radiation oncology and nuclear medicine). This happened in a time that both academic and clinical institutions have undergone significant changes. Old-style 'technikons' (the institutions in which radiographers were previously trained) are in a process of becoming 'universities of technology', whose new mission is to further build and engage their real world focus with improved connectedness across teaching, research and service.

The emerging strategic differential of the new institution (where this case study is based) is located at the 'heart of technology education and innovation in Africa' (Cape Peninsula University of Technology, 2005). The institution has identified a new Faculty of Health Science as a key contributor to its strategic objectives. The clinical and academic departments of radiography are strategically positioned to contribute to technology-delivered practices that specifically serve a diverse socio-cultural patient community. As in most clinical departments, undergraduate student radiographers in this case study contribute to service delivery while meeting the curriculum need for clinical experience in real world practical settings. This is not accomplished without some tension as departments balance educational needs and service needs with limited hospital budgets and a shortage of qualified radiographers.

At the regional level, radiographers experience a changing clinical environment. This involves a culturally and linguistically diverse patient population whose many needs must be met within a context of diminishing resources for tertiary health care. Within the relatively affluent Western Cape, there is an increase in private radiographic provision, usually with state-of-the-art facilities. This province also has townships and rural communities in need of basic facilities, such as ultrasound scanning for pregnant women, diagnostic radiography for communities at high risk of TB infection, and imaging radiotherapy for those with HIV-AIDS and malignant disease. Many undergraduate radiographers are learning the values of responsible citizenship, and increasing their own skills, by providing these services through community-based service learning.

The contextual description above implies several challenges for radiography education in South Africa. Radiographers need to be confident and knowledgeable contributors to integrated patient care teams. Like their global colleagues, South African radiographers need to become 'supertechnologists' (Friedenberg, 2000), competent in the application and management of complex, state-of-the-art technologies but they must have the ability to adapt their skills and knowledge to the under-resourced African and South African contexts. The South African higher education transformation agenda requires access for students who were excluded from becoming radiographers by the policies of the past. South Africa, as the technology leader of the continent, also has an obligation to make its training facilities available to radiographers in Africa more broadly. Thus the radiographer-in-training is likely to have a home language other than English and to come from a community that did not previously have access to tertiary health care. It is within these changed contexts that reinterpretations of radiography education are being made. At the conceptual level, radiography education must take into account global, national, regional and local contexts, as illustrated in Figure 1.1.

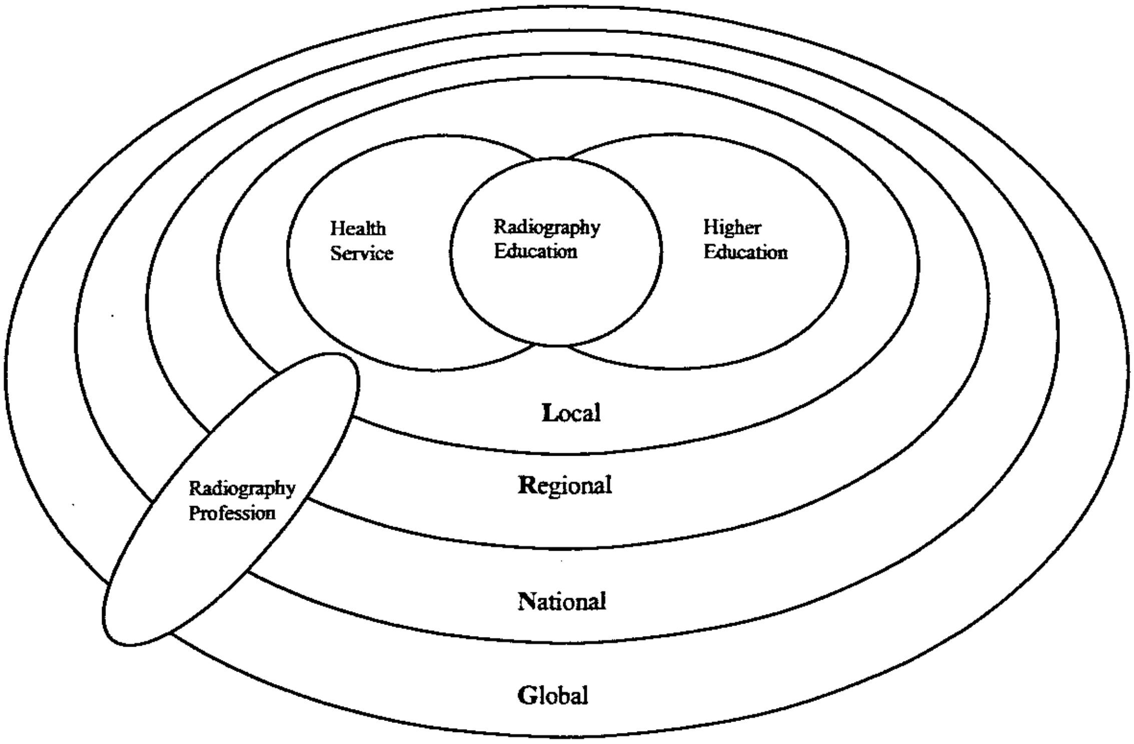

Figure 1.1: The contexts of radiography and radiography education

The changes discussed in this chapter are taking place in the contexts illustrated in Figure 1.1. These changes require educators to reconceptualise the education and training of radiographers. The conventional training of radiographers is based on the disciplines of physics, chemistry, anatomy, physiology and pathology within the applied discipline or specialisation of radiation medicine. Students learn the disciplines in separate 'compartments' or 'silos', and are expected to 'self-integrate' the foundational disciplines of radiography during clinical practice. Traditional radiography curricula are therefore not closely aligned with the needs and contexts of the changing clinical environment. There is a considerable body of research in health science and medical education which underlines the difficulties that new interns experience in the transfer of classroom-based knowledge to the clinical environment (Prince & Boshuizen, 2004; Balla, Biggs, Gibson, & Chang, 1990). In the radically changed context of health care technology and practice, where the only certainty is continuous change (Dent, 2001), traditional models of radiography education are increasingly felt to be inadequate. The previously narrow vocational training of radiographers does not meet the educational needs of radiographers 'at the heart of technology in Africa'.

1.3 The Research Focus

The research was conducted in one of the best-resourced provinces, though in one of its most unequal cities where much must still be done to improve the living conditions, health care and education of many people (Thom, 2004). I argue that, in order to prepare radiographers for the changing technological, professional, and social contexts, their education should take the form of a particular type of integrated curriculum. I term this an 'Integrated Learning Curriculum' (ILC). Curriculum renewal in response to the changes in higher education and health care in South Africa (Engel-Hills, 2005a) has afforded the opportunity for research on the development and implementation of such a curriculum.

In health science education there are many examples of an integrated curriculum being implemented (Reser, 2000; University of Vermont, 2003; Dunaway &

Faingold, 2001). These challenge the traditional curriculum of connecting subject-based theory education with interspersed clinical experience, where there is reliance on students connecting or applying the subject content of the classroom to clinical practice. The ILC that was planned to enhance the integration of teaching and learning in the academy and workplace, has certain features in common with other forms of integrated curricula but the proposed version was designed to address both the difficulties encountered when educators work in integrated ways and to respond to the changing needs of the evolving radiography profession in a transforming South Africa. The study took advantage of the opportunity to capture data and learning from this curriculum renewal with the focus of this research being the ILC. The study being specific to an integrated curriculum in radiography in South Africa is the first such research within this context. It therefore has the potential to provide a basis for further research on other aspects of curriculum and integrated learning in radiography.

Due to varied understandings of integrated curriculum this research addresses two components: firstly, the goal and definition, and secondly, the structure of the ILC. In this study design, the experience of an ILC at one site was studied in this dual way to contribute to the understanding of what an integrated curriculum could and should be.

Data on the opinions of students, academics, and practitioners were gathered, as well as extensive continuous document review, over a three-year period. The findings from the study have been integrated with findings from other sources, including the research done to establish the context within which this radiography programme operates. The key learning from the conceptualisation, design and implementation of an ILC is the research findings presented in this thesis. There was immediate benefit to the programme, and there is potential benefit to radiography in other contexts, as well as to all health science programmes. The findings may even contribute to higher education beyond the limits of health science, within the professional education arena.

1.4 The Research Questions

This study takes account of the local, regional, national and global context of the selected case of curriculum renewal in radiography. This research studies particular aspects of an integrated radiography curriculum in depth in order to facilitate a 'layered' understanding of integration and an integrated curriculum. To account for the strategic, conceptual and operational levels, it was beneficial to explore how the curriculum was conceptualised, implemented, and evaluated. Through the investigation of the design, implementation and evaluation, there was a better understanding of the realisation of the curriculum within the specific context. The questions below provided a framework for the way in which the research guided the understanding of curriculum integration, helped to expose assumptions, and provided models of curriculum integration and their associated criteria.

1.4.1 What is the nature of radiographic knowledge?

This research question addresses the theoretical underpinnings of radiography as a discipline and as professional practice. There are many assumptions about the knowledge, skills and values that radiographers have, and the first research task was to open up the 'black box' (Latour, 1987) of radiographic knowledge, with reference to the literature, academic radiographers, practitioners, and students.

1.4.2 What curricular options would facilitate radiographic knowledge?

Given that there are a variety of understandings of curriculum, this research investigates the nature of curricula in general, and radiographic curricula in particular, as well as attendant definitions and structures. Through a process of identifying the similarities and differences from the perspectives of participants, and by investigating the process of conceptualisation and implementation of a radiographic curriculum, it was possible to categorise curricular types.

1.4.3 What would enable or constrain successful curriculum implementation?

Curriculum conceptualisation straddles the strategic and operational levels of curriculum and impacts on the achievement of key objectives as well as the design and implementation of the programme. At the operational level, curricula are localised in terms of resources (including human, infrastructural and financial resources). It was therefore necessary to consider the implementation of the curricula broadly in order to gain an understanding of the realisation of a radiographic curriculum within a specific context.

1.4.4 Is the ILC an appropriate curriculum for Radiography?

This research question focused on the rationale for, and projected benefits of, introducing a particular type of curriculum, the ILC. It addressed how the ILC at the selected site contributed to such goals as developing skills for participating in a multidisciplinary team, students being active learners who manage their own learning and enhanced clinical competency in radiography practice.

The success of any curriculum initiative requires a partnership between the higher education institution (the academy) and the clinical radiographic facilities (the context of application, workplace or world of work). This shared responsibility and co-operation is a partnership throughout the phases of educating a radiographer. It starts with the joint selection of the students and continues throughout the programme to ensure that well equipped graduate practitioners have access to the radiography profession.

1.5 Towards an integrated learning curriculum

For some time, in a variety of educational contexts, curriculum planners have turned to interdisciplinary and integrated approaches to encourage deep, meaningful learning rather that rote learning (Jacobs, 1989; Humphreys, Post & Ellis, 1981; Klein, 1997), and build capacity for critical thinking (Perkins, 1991), creative problem-solving (Caine & Caine, 1991), and life long learning (Payne &

Nixon, 2001). The quotation below, from a pioneer in curriculum integration, makes many points that are still valid:

> In an integrative curriculum, the planned learning experiences not only provide the learners with a unified view of commonly held knowledge (by learning the models, systems, and structures of culture) but also motivate and develop learners' power to perceive new relationships, and thus to create new models, systems, and structures (Dressel, 1958: 3-25).

Integrated learning in the form of problem-based learning has long been implemented in health science education; its origin is traced to McMaster University in Canada (Spaulding, 1969; Haslett, 2001). Integrated learning approaches include a range of strategies that may be implemented throughout an entire curriculum, a single unit of study, or part of a unit of study, in large and small group teaching settings, (Bebb & Pittam, 2004; DiPasquale, Mason & Kolkhorst, 2003; Magnussen, Ishida & Itano, 2000). Integrated learning may therefore be understood as a broad umbrella term that includes a range of learning approaches including problem-based learning (McLean, 2004; Thom & Cullinan, 2001), project-based learning (Curtis, 2005), thematically organised learning (Lipson *et al.*, 1993), work-integrated learning (Adamson, Harris & Hunt, 1997) and learning communities (Gabelnick *et al.*, 1990).

Boyer's (1990) notion of 'scholarships' has lent additional emphasis to the idea of integrated curricula in higher education. The scholarships of teaching, discovery, and application are aligned with South African higher education's three core areas of teaching, research, and service. Boyer's fourth scholarship, the scholarship of integration, has implications for how these three core areas of endeavour are brought into meaningful relationship in the curriculum.

> ...future scholars should be asked to think about the usefulness of knowledge, to reflect on the social consequences of their work, and in so

> doing, gain understanding of how their own study relates to the world beyond the campus (Boyer, 1990: 69).

Boyer's integrative idea is aligned with an emerging vision of radiography as a professional community of technological innovators, academic and clinical educators, practitioners, and students who work together with other health professionals in the best interests of patients. The new university-based radiography curriculum requires educators to be both disciplinary experts and integrative experts who are interpreters and facilitators of the learning process. The transmission of narrow discipline-based knowledge to students is an outmoded conception of academic work, for 'knowledge is not necessarily developed in such a linear manner' (Boyer, 1990). Teaching, research, and service should each influence the other, and benefit student learning.

Biggs's (2003) 'principle of alignment' sits comfortably with integrated approaches to radiography education. University of technology curricula are generated by academics and practitioners to prepare students for a particular career. In this context, the curriculum becomes an element of the constructive alignment paradigm (Biggs, 1996) where each of the elements must be in harmony with the others if the outcomes of the programme are to be achieved. Dator (2004), in praise of the International Space University's educational programmes, states that technology-driven curricula should include the 'Three I's', by which he means that they should be: 'Interdisciplinary, Intercultural, and International'. The radiography curriculum requires a few more 'I's': it also needs to be Innovative, Interpretive and Integrative if it is to include the principles of Boyer's scholarship of integration:

> ... making connections across the disciplines, placing the specialities in larger context, illuminating data in a revealing way ... serious, disciplined work that seeks to interpret, draw together and bring new insight to bear on original research...[it involves] first doing the research at the

> boundaries where fields converge ... such work is ... increasingly important as traditional disciplinary categories prove confining, forcing new topologies of knowledge [and] fitting one's own research – or the research of others – into larger intellectual patterns (Boyer 1990: 2).

Integrative scholarship in radiography encourages interpretation of that which has been discovered in ways that provide a larger, more comprehensive understanding for both clinical and academic work. For these reasons, the scholarship of integration is viewed as central to the formation of a learning community in radiography. It is the collective and collaborative activity which binds together and finds new and renewed groupings across disciplines.

1.6 Why integrate the curriculum?

We have begun to understand that knowledge is produced through shared intellectual endeavour. This approach, known as 'mode 2' knowledge production (Gibbons *et al.*, 1994), brings together multidisciplinary groups to solve problems collaboratively. This is in contrast to traditional, discipline based 'mode 1' knowledge generation that tends to give rise to 'compartmentalised' perspectives. Mode 2 approaches, that draw on expertise from different professional and disciplinary paradigms, are particularly suited to solving problems in the health sciences (Everingham & Harris, 2000; Stark, 1998; Klein & Newell, 1996), which are facilitated by interdisciplinary and inter-professional problem-solving in undergraduate curriculum.

Higher Education is increasingly recognising the need for educational practices that prepare students for the real world (Ramsden, 1992). In the case of radiography students, there is a need for teaching, learning and assessment practices that build competence and confidence within a clinical environment. These include professional interdisciplinary team work (Monkman & Baird, 2002) that facilitates the theoretical understanding and reflection on experience that is needed for integration of work experiences into academic study (Schön, 1987), and that builds responsible citizenship (Winberg, 2006; Philotheou, 2004; Waghid, 2002).

Research thus suggests that integrated approaches, which are appropriate to the students' stage of educational development and their learning and working contexts, can engender those generic skills required by university graduates in the 21st century (Biggs, 1999; Ladewig, 1987). An integrated approach, with learning at its centre, is appropriate to South Africa, as the curriculum has the multiple aims of improving the preparation of graduates for the technologies, clinical environments, and social contexts of the future (McLean, 2004; Thom & Cullinan, 2001).

1.7 Why put learning at the heart of the curriculum?

In an integrated curriculum, student learning is placed at the heart of the curriculum. Integrated approaches to learning place emphasis on student autonomy, in areas such as negotiating learning objectives, identifying, accessing and using resources, and assessing students' progress. Integrated learning accords with constructivist models of learning, in which knowledge is understood to be constructed when individuals and groups actively engage in learning experiences (Fosnot, 1996; Hendry, Frommer, & Walker, 1999).

Furthermore, a learner-centred curriculum meets individual needs by being an inclusive and supportive learning environment that caters for the increasing diversity among commencing student cohorts and is therefore likely to make the difference between success and failure (Wyrley-Birch, 2004). Clinical and academic educators therefore need to respond to student diversity and multilingualism in ways that will enable each student to become a confident, self-directed, and independent learner.

A curriculum that is learning-focused will help to guard against the danger of trying to keep up with the rapid pace of technology development in radiography by cramming ever more content into already overloaded curricula. In some cases this has led to hastily drawn up programmes that attempt to cover an unrealistic amount of material in a given timeframe (Millmow, 1997). In addition to the content burden, students must also be able to learn to practise in transformed settings; indeed, they are probably going to practise in settings not yet imagined (Crawford, 2001; Fook, Ryan, & Hawkins, 2000). Curriculum developers thus do not always have access to the technological content knowledge or contextual knowledge that students will need to master when they enter the profession. It is only by putting *learning* at the centre of the curriculum, and building independent and life long learners, that educators will be able to prepare their students for uncertainty and change.

1.8 What do we know about integrated curricula?

It has been found that the development of competence in clinical and academic contexts is facilitated by range of educational practices, variously known as 'multidisciplinary', 'interdisciplinary', 'transdisciplinary', 'multi-professional', and 'inter-professional'. These involve students, academics and health professionals from different disciplinary backgrounds, teaching, learning and working together (Graham & Wealthall, 1999; Pirrie, Hamilton, & Wilson, 1999). A continuum of educational strategies for integration (Harden, Snowden & Dunn, 1984 & Harden, 2000) refers to interdisciplinary knowledge, reciprocity between theoretical and practical knowledge, work preparedness and the inclusion of generic competencies in the curriculum that aim at the holistic development of students as an outcome of the integrated curriculum. Integration in professional education appears when academics seek innovation and a curriculum that promotes openness, flexibility, depth, and breadth in learning programmes. Such a view of curricular integration is likely to accommodate the vertical and horizontal knowledge needs of professional education (Bernstein, 1999).

The integration of basic competencies, such as technical communication within the mainstream curriculum, has greater learning benefits than teaching these in separate courses (Winberg *et al.*, 2005; Wyrley-Birch, 2004; Meckler, 1992). Teamwork and shared learning experiences have the potential to increase understanding of the roles of inter-professional teams and promote future teamwork and cooperation between different professional groups (Barr, 2003; Breslow *et al.*, 2005).

'Compartmentalised' curricula do not equip graduates with a shared understanding of professional roles, or the range of skills necessary for working in multidisciplinary, technically advanced clinical environments (Adamson, Harris & Hunt, 1997; O'Connell & Pascoe, 2004). Significantly higher proportions of students and educators report satisfaction with cross-disciplinary studies in terms of adapting to new technologies in clinical environments (Harris, Heard & Everingham, 2005).

In the health sciences, the need for an interdisciplinary focus in curricula has been recognised internationally as an imperative for graduates who will work with technology, other professionals, and patients in clinical settings (Lavin *et al.*, 2001). Particular benefits have been documented with regard to inter-professional initiatives designed with upper level medical, radiography, nursing, dental, occupational therapy, physiotherapy and orthoptic undergraduates or post-graduate students (Leaviss, 2000; Freeth *et al.*, 2002). The National Health Service in the United Kingdom has called for teamwork to be enhanced in health professional workplaces and suggested that 'outdated demarcations and barriers between health and social care must be broken down through increased interprofessional work' (Wrightson & Cross, 2004). 'Learning on the job' is enhanced when curricula include teamwork, the fostering of networks, and participation in shared projects (Ashton & Sung, 2001).

1.9 Implications for radiography education in South Africa

When the concepts and findings of integrated curricula are mapped over those of the basic outcomes required for radiographic practice as submitted to SAQA in

1999, a model emerged (Table 1.1) around which to conceptualise the ongoing teaching, learning and assessment of radiographers-in-training. The characteristics of the model suggest both a new vision and structure for radiography education.

Table 1.1: Characteristics and Rationale for an 'Integrated Learning Curriculum'

Characteristics of an ILC	**Rationale for the ILC**	**Evidence based sources**
Meta-learning	Learning how to learn, and thus becoming life long learners, is the only way in which students and practitioners will be able to adapt to rapidly changing technology.	Hendry, Frommer, & Walker, 1999; Malhotra, 1996
Transparent learning objectives	These are minimum competencies for radiographic practice in the diagnostic and therapeutic disciplines.	Harris, Heard & Everingham, 2005
Thematically organised learning - Content - Scope - Sequence	The learning objectives are integrated into themes (e.g. 'The Chest') which are meaningful for both academic study and clinical practice, and where the scope, level and sequencing is appropriate to the level of the learner.	Bebb & Pittam, 2004; Graham & Wealthall, 1999; Pirrie, Hamilton, & Wilson, 1999
Knowledge generating	Radiographers as life long learners that can adapt to changing contexts and develop their emerging profession will be an outcome of a knowledge-generating curriculum.	Freeman, Miller, & Ross, 2000
Problem & Project based learning	Beyond thematic integration, students who work on a real-world problem (e.g. helping to prevent the spread of TB in the Western Cape) develop not only skills, but 'insights'.	Rothenberg, 2002. Everingham & Harris, 2000; Stark, 1998; Klein & Newell, 1996.
Work-integrated learning	A variety of curricular practices, such as work-based projects, in-service training and sandwich courses, facilitate the transition from academic classroom to professional working environment.	Engel-Hills *et at*, 2005; Adamson, Harris & Hunt, 1997.
Contextual learning	In order to build competent and caring professionals, there is need for contextually based learning, including learning in 'high tech' environments and in community-based contexts, such as through service learning.	Winberg, 2006; Philotheou, 2004; Waghid, 2002; Adamson, Harris & Hunt, 1997.
Team learning	Group based learning simulates real world contexts in which there is inter- and intra-professional collaboration.	Wrightson & Cross, 2004; Barr, 2003; Lavin et al., 2001; Bines,1992.

Sustainable assessment	Assessment practices should not only be aligned with integrated teaching and learning practices, but must support learning beyond the higher education setting.	Boud & Solomon, 2000.
Learning support - information literacy - language support - infrastructural support - administrative support - flexible scheduling	Integrated curricula have many features of resource-based learning programmes, thus students need to develop information literacy. In multilingual settings, support is needed for technical communication. Infrastructural and administrative support is needed for new practices, and teaching loads and learning timetables need re-visiting.	Winberg *et al.*, 2005; Wyrley-Birch, 2004; Schön, 1995;

The 'Integrated Learning Curriculum' draws on ideas about altered conceptions of the role of universities, and the new ways in which academic disciplines and scholarship are being thought about. The implementation of these concepts (as Schön [1995] has observed with regard to Boyer's scholarships) requires new institutional structures to accommodate academic work conceived around curricular integration. Clark's (1998) investigation of five European universities revealed that transformation in academic institutions, as in all large organisations, is difficult. Organisational change can be understood as stages in a process of loss and grief (Kubler-Ross, 1989). Trowler (2004) points out that change does not always yield the expected results, and that small, well-supported initiatives are generally more successful than large scale restructuring where unforeseen changes within the context can force modification from the radical to a more hybrid approach (McLean, 2004).

Change requires leadership, institutional support, and resources. Attempting to implement an integrated curriculum in the absence of resources, for example, is to set oneself up for failure. There are examples of institutions adopting integrated principles, either explicitly or implicitly, in their missions for higher education (Yoshida, 2002). These include: the physical built environments (Mount Holyoke College, 2003/4), new organisational structures (Royal Melbourne Institute of

Technology, 2004), new processes of networking (University of Vermont, College of Medicine, 2003), and new cross-organisational divisions, such as the Engineering Systems Division at the Massachusetts Institute of Technology (2004). Integration is a more unsettling concept than weaker forms of 'connectedness' for traditionally strong disciplinary curricula. The implementation of an integrated curriculum can require a paradigm shift for all participants. Perceptions of curriculum design will be influenced by the participants' ability and willingness to make this shift (Naicker, 1999).

The particular situation in South Africa, which includes the reconceptualisation of both health care and technological higher education, provides opportunities for a 'scholarship of integration'. One such opportunity is the establishment of a new university of technology, whose mission is to be 'at the heart of technology education and innovation in Africa'. To reposition the academic heartland of radiography requires, in the first instance, curriculum renewal for radiography education, under the guidance of a steering core of change agents. The team of radiographers at the research site are aligning their work with this scholarly mission, to pioneer transformational practice within academic and clinical environments. They are an embodiment of Boyer's reconsidered scholarship in building cultures, practices, structures and strategies for the new radiographer.

1.10 The researcher's position

Higher education and health care broadly respond to the changing contexts by drafting policy, procedure and regulations. However, it is the individual who must choose how to respond. Interpreting and applying such high level policy to the local context will drive change and bring about transformation and curriculum renewal; not doing so will ensure continuation of the status quo. So it rests with the innovators and determined educators to initiate curriculum renewal, despite the web of administration and bureaucracy that engulfs them and the many challenges arising from doing things differently.

As an individual who has experienced a webbed curriculum (Fogarty, 1991); this being a curriculum where themes are used to connect the concepts, topics and ideas in each subject, I will attempt to authenticate the research data by providing a selective narrative of my life as a radiographer practitioner, educator and researcher. This narrative will present a lens through which the apparently independent and disconnected elements can be viewed as related parts. There is a link from the global, through the national, regional and local contexts to each individual radiographer. As the researcher, I use my own story to represent the individual radiographer and to state my position as a researcher of the ILC. This summary narrative reflects the central theme of my life in radiography and identifies the core categories of practice, educational, and research environments. I present only what I consider necessary to frame this research, as an 'insider' in the process of curriculum renewal.

1.10.1 The clinical radiography practitioner

Radiography has been a part of my life for over 30 years. I entered diagnostic radiography as a student of a hospital-based training course at a large tertiary hospital. After qualifying, I had clinical experience locally and in the United Kingdom before returning to South Africa to study therapeutic radiography. Thereafter, I worked in The Netherlands for a few years before returning home to take a position in radiation oncology. During this time I developed an interest in education and completed a university Diploma in Teaching Radiography and a Higher Diploma in Radiography. Soon after qualifying I took up the role of tutor in a Radiation Oncology department. I had the desire to continue my studies. It was a lengthy process but I successfully completed an honours degree in Radiation Therapy and this encouraged me to become involved in research and publishing (Hills, 1987; Hills, 1988). As a radiographer, I have always been involved in the South African professional society, holding regional and national portfolios in the professional structure and being on the organizing committee of national conferences.

1.10.2 The radiography educator practitioner

I was extremely content as a clinical practitioner and hospital-based tutor. However, I took up the challenge and, in 1992, accepted an appointment as senior lecturer at a University of Technology (previously a Technikon) when the restructuring of radiography education in South Africa transferred the responsibility for radiography training from hospitals to higher education institutions. This has been a time of rapidly escalating change bringing with it new opportunities and challenges. I developed a passion for curriculum (Engel-Hills, 1994), retained my love of radiation oncology and completed a Masters degree in Medical Physics (Engel-Hills, 2001 & Engel-Hills, 2002). These interests allowed me the opportunity to attend and present at local, national, and international conferences that spanned radiography, radiation oncology, radiology, health science education, academic development and research ethics.

My national interest in radiography grew throughout the sixteen-year period that I was a member of the Professional Board for Radiography (and Clinical Technology) and in my final term of office I was chairperson of the board and a member of the Health Professions Council of South Africa.

I have also been able to extend my contribution to radiography to the continent of Africa. As a unit, our Radiography Education division are committed to educating radiographers beyond our borders and have a growing list of international students. My connections with the International Atomic Energy Agency (IAEA) have resulted in my appointment to a panel of experts to develop a syllabus for Radiation Therapists in Africa that will now be adapted and translated for use in other developing countries. I have also been involved in audits of Radiation Oncology departments in Africa.

The physicist and scientist Marie Curie inspired me because of her determined experimental research under difficult conditions and her attitude toward knowledge, learning, and teaching (Curie, 1938). I too want to build a better world where each individual strives towards their highest development, and is a responsible citizen. I can achieve this by being available to those who will benefit from my help and so assist the development of society. Therefore, within a small team of motivated academics willing to engage with the transformation and development agenda of South Africa, I took on the role of initiating curriculum renewal by personal choice rather than job designation. This journey has unsettled my 'comfort zone' and I am now more critically aware of what I do as an educator and researcher.

1.10.3 The researcher

I entered this research with enthusiasm for being a radiographer and a radiographer educator. It is the love of these two components that motivates and drives me. The research questions come from an integration of the fields of radiation medicine and health science education. As a researcher, I am committed to seeking connections and meaning in the logic of my worlds to better understand these worlds and explain the actions of the actors in them. My involvement in a multi-disciplinary research team (Engel-Hills *et al.*, 2005) has moved me more and more towards qualitative methodology because of the importance of context in the qualitative paradigm; yet I retain respect for quantitative research methods that I will continue to incorporate into my research.

The tension of team player and independent practitioner benefits my research in that I am an individual and yet irrelevant without the partnerships that I value. So it is that, as the person presenting the research in this thesis, I sometimes hold the position of an 'insider' who endeavours to suspend judgment and consider alternative points of view in my world; at other times, I am the researcher who gleans knowledge from an 'outsider' perspective as it is relevant to my world. This accounts for the construction of a thesis that considers the ILC from its implementation locally in a radiography programme to its place in the wider world.

1.11 Introduction to the thesis structure

Here I provide a brief overview of the structure of the thesis.

Chapter Two

In this section I provide an overview of key areas, issues, and debates in the theoretical and research-based literature on curriculum integration, for the purpose of building a framework through which the research findings can be interpreted and understood.

Chapter Three

In this section, the research design, methodology, and method of the research project is explained. The research design can briefly be described as multi-method approach, although predominantly qualitative in conceptualisation.

Chapter Four

The findings of a national survey on radiography education in South Africa, as relevant to the ILC, are presented in this section.

Chapter Five

The findings of the case study of the radiography ILC are presented in this section.

Chapter Six

In the final chapter, I present a framework for integrated curriculum that includes curriculum as a process, a typology, a structure, and propose criteria useful for curriculum design and for the evaluation of an integrated curriculum. Conclusions and recommendations are made to consolidate the findings and interpretations presented in the previous two chapters. This chapter serves to build knowledge on integrated curriculum in the health sciences.

2. A review of the literature on curricular integration

> It is taken for granted, apparently, that in time students will see for themselves how things fit together. Unfortunately, the reality of the situation is that they tend to learn what we teach. If we teach connectedness and integration, they learn that. If we teach separation and discontinuity, that is what they learn (Humphreys, Post & Ellis, 1981: xi).

The review of the literature presented in this section is intended to build a conceptual framework with which to understand and analyse curricular integration. Towards this end a structured literature search was conducted using appropriate key words. While an attempt was made to cover important literature in radiography there were but five sources identified as relevant to this study. This indicates a lack of radiography literature related to curriculum and in particular to integrated curriculum and is the reason why reference to medical education and nursing is more frequent. Literature was selected from the results of the search, however the referenced texts go beyond this and include texts identified by supervisors, other academics and researchers, through conference and workshop attendance and from the references of texts read. Information on the design, implementation and experience of curricular integration in higher education generally, and in health science in particular, conceptually frame the research questions and the research findings. This overview of the theoretical and empirical research literature addresses the nature of radiographic knowledge and curriculum development and implementation, particularly with regard to integrated curricula in the health sciences. An argument is presented, from the literature, for the appropriateness of learning-focused curriculum integration in radiography.

2.1 Radiographic knowledge

The underpinning of a curriculum is knowledge. Radiographic knowledge, which is the knowledge that supports radiographic practice, includes disciplinary knowledge, professional knowledge and clinical knowledge. Radiographers-in-training are in the process of both learning existing radiographic knowledge, and producing new radiographic knowledge. This sub-section is an overview of the literature that contributes to an understanding of the knowledge base of radiography.

2.1.1 Radiography and disciplinary knowledge

Radiography, like many applied sciences, is built on the traditional biological, physical and social science disciplines, such as anatomy, physiology, physics, and psychology. Radiography selects and adapts knowledge from these disciplines and, in addition, includes areas such as radiation science, imaging and pattern recognition. It is therefore possible to understand Radiography as an inter-discipline, or even trans-discipline. In terms of Biglan's (1973) taxonomy of the disciplines, Radiography can be located in the hard/applied quadrant (Figure 2.1):

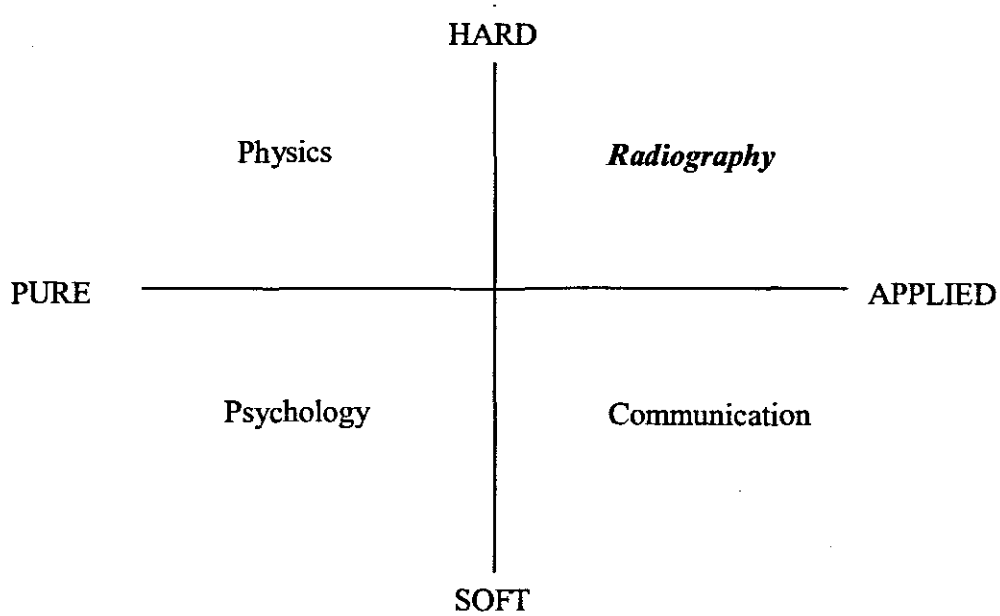

Figure 2.1: Radiographic Knowledge, adapted from Biglan (1973).

Radiography does not fit entirely comfortably into Biglan's taxonomy. As an 'interdiscipline', it would include at least some knowledge from the hard/pure quadrant, such as Physics, as well as from the pure/soft quadrant, such as Psychology and the soft/applied quadrant such as Communication. It would therefore be more accurate to represent Radiography as overlapping the quadrants, with the greater part of the knowledge area falling into the hard/applied quadrant. Rethinking the knowledge base is a process that is taking place in radiography; what is emerging is the concept of the transdisciplinary 'supertechnologist' (Friedenberg, 2000).

Bernstein (1999) suggests that the concepts of 'verticality' and 'horizontality' are useful analytical tools for understanding forms of knowledge. 'Verticality' represents the kind of knowledge that is abstract, theoretical, or based on traditional disciplines (such as Physics or Sociology). Vertical knowledge moves beyond the specific, it is knowledge shared by a specialist community; it involves abstraction and generalization; and it tends to be inflexible and difficult to change, other than through accepted rules. Particular pedagogies and adherence to these rules are involved in the acquisition of vertical knowledge. Vertical knowledge can be understood as the basis for the thinking process that enables making connections and looking for alternatives. Horizontal knowledge, on the other hand, is additional, flexible and changeable. It is typically knowledge acquired through experience or 'acting in the world'. Horizontal knowledge tends to be specific to a local context and is likely to be oral, tacit and contradictory across, but not within, contexts. It can be likened to knowledge gained through 'situated learning' in a 'community of practice' (Lave &Wenger, 1991). Young (2005) points out, that Bernsteins' distinctions do not describe different types of knowledge, but rather 'refer to features found to a different degree in all claims to knowledge: they are, in Max Weber's sense, "ideal types"' (Coser, 1977: 223-224). Horizontal and vertical knowledge are thus not exclusively found in the workplace or in formal teaching sites but, rather, both types of knowledge can be found in both sites. Organisation of the workplace may depend on vertical knowledge as well as horizontal knowledge, gained through practice in a particular site. While there is a theoretical distinction between the two types of knowledge, they are neither superior nor inferior to each other, but different in how they are produced and transferred within and beyond the context of origin. In radiography there is the need for vertical discipline-based knowledge and horizontal generic and clinical workplace knowledge; and both are needed to educate a radiographer.

2.1.2 Radiographic professional knowledge

Health care practitioners and medical doctors in particular, have long been considered 'professional'. Still there is continuing debate around the definition of a profession, and the criteria for a group of practitioners being professionals. Some might even say that a profession is a profession because the public think of it as such (Ellis, 2004). According to Abbot (1988), professions can be viewed by their jurisdictions, the tasks they do, the expert knowledge required to perform the tasks, and the ways in which internal and external forces compete to change both the jurisdictions and the tasks. Therefore it is within the changing context of health care that all practitioners within the system are increasingly being considered to be professionals. Like other 'professionals', radiographers have specialised knowledge, professional standards and ethics. They are subject to critical evaluation that is considered to be the key to the new professionalism within the context of explicit standard setting, self-regulation and reaccredidation. If the existence of professions is accepted then some wider investigation of what contributes to this status is worthwhile in the context of radiography education and training.

Lave and Wenger (1991) first developed the idea that learning is a process of participation in communities of practice and that this participation is initially 'legitimately peripheral' but increases gradually in both engagement and complexity. Over time, the members of the community of practice are united through participating in common activities, and there is collective learning through this shared practice (Wenger, 1998). The Lave and Wenger (1991) model can be applied to the shared repertoire of ideas, accumulated knowledge, memories, identities, and commitments of the radiography community of practice, where there is a shared way of doing and approaching practice.

There is, as Jarvis (1999a: 271) puts it, a 'body of knowledge that has been regarded as an essential prerequisite for radiography to be considered a profession'. Cumulatively this can be considered as the professional knowledge base of radiography. Acquiring integrated and structured knowledge through learning experiences with direct clinical relevance facilitates professional development by providing a knowledge base for rational problem-solving that promotes clinical reasoning (Dunaway & Faingold, 2001). Reser (2000) extends the integration of basic and clinical sciences to include the social sciences, which are critical to the development of health care professionals. Learning is enhanced if it is placed in the social relationships of the collective life of the community of practice through consistent engagement rather than being viewed as merely the acquisition of certain forms of knowledge (Lave & Wenger, 1991).

Abbott (1988) suggests that the knowledge system of professional practice has three facets: diagnosis is the process of taking information into the professional knowledge system; treatment is when instruction to the client is brought out of the system; and inference is the process that takes place when the link between diagnosis and treatment lacks clarity. Abbott (1988) also argues that the three most significant cultural changes that have contributed to altering the work of professions are knowledge-based issues: the growth in the amount and complexity of professional knowledge, the emergence of new types of legitimacy claims for that knowledge, and the rise of the university. The universities' legitimate professional knowledge and expertise generate new knowledge that impacts on practice, educate professionals and are a space for inter-professional competition.

Abbott's (1988) main point is that professions do not function separately but they relate to each other in an interdependent system of cooperative and competitive relationships where changes in one profession cause a disturbance in the system of professions. The jurisdictional boundaries are constantly disputed as the professions compete over the work that they do. It remains the domain of the professions to design the requirements for entry into the professional body, and this tends towards a rigid career pattern for most professions, with poor inter-professional mobility and strict professional limits. Through limiting access, the demand is for activities at a level the professionals vacate. As they do new tasks beyond the boundary, opportunities are created for other groups to move into the gaps.

Perkins (1992) identifies a range of 'knowledges' that are related to professional knowledge, each of which can be achieved at different levels of learning:

Content knowledge

Content knowledge comprises the facts, concepts and routine procedures of the discipline, which the professional-in-training is expected to acquire.

Problem-solving knowledge

The professional-in-training is expected to solve typical formulaic problems in the discipline.

Epistemic knowledge

Professionals-in-training are expected to acquire knowledge of the rules of doing tasks within the discipline. Epistemic knowledge also involves using these rules in explanation, justification, and problem-solving activities.

Inquiry knowledge

Professionals-in-training are expected to challenge results and construct new knowledge.

Perkins's (1992) model correlates with the 'applied competence' which the South African Qualifications Authority (SAQA) wants learners in South Africa to strive for (Enslin, 1998). Applied competence is defined as: 'the ability to put into practice, in the relevant context, the learning outcomes acquired in obtaining a qualification' (Du Pré, 2000: ii & SAQA, 2000: 21). A further explanation of applied competence is:

> The demonstrated ability to consider a range of options/possibilities, make decisions about practice and perform tasks (practical competence).
> Demonstration that theory underpinning the task is understood showing understanding about what is being done and why (foundational competence).
> The demonstrated ability to connect understanding with performance such that there is learning from actions and the ability to adapt to changes and unforeseen circumstances as well as to pass reasoned judgement on different ways to perform the task (reflexive competence) (Enslin, 1998: 8).

There is a connection between professional competence and applied competence as both are developed and assessed in a context. Professional competence is the ability of a person to respond appropriately to an environment; applied competence is a set of skills that are listed, have assessment criteria attributed to them and can be assessed (Department of Labour, 1997). Vorwerk (2002) describes the applied competence required in the manufacturing context as complex and dynamic. This is also true in radiography where the notions of radiographic competence and applied competence are appropriate, provided that there is appreciation of the practice being within a diverse, changing and highly complex environment.

Rip (2003a) suggests a 'T-shaped' model for professional knowledge in the 21st century, where the depth of the professional's disciplinary knowledge is the downstroke of the 'T', and the cross stroke represents transcontextual collaboration with other disciplines to address inter-disciplinary challenges. In this sense, we can think of radiographers as 'T-shaped' professionals, having both specialised vertical knowledge, and contextual, inter-disciplinary, practical knowledge.

2.1.3 Radiographic practice knowledge

The knowledge of the radiographic clinical workplace can be considered as 'practice knowledge'. There are many terms such as work-related learning, work-based learning, and work-integrated learning that attempt to capture the notion of work and learning as a joint event. While these terms may appear to represent a single knowledge type, each of them is used in diverse situations to describe the type of higher education in which students gain some real world experience (Foster, 1998). All of these terms have something to offer in understanding radiographic knowledge.

Learning and Knowledge in the workplace and higher education

The discourse and structure of education institutions and the workplace is different. The implicit and contextual nature of working knowledge does not easily fit into the traditional education practices of higher education that depend on knowledge that is explicit and generalisable (Chappell, 2000). In the workplace, work-based learning is the action of working and through work there is learning. This learning takes place because of doing work (Foster, 1998). In some cases there may be no formal teaching and all learning takes place through being in the workplace. However, there is usually a teaching and learning partnership, even if the teaching is informal and 'on-the-job'. In some work-based learning models there is a formal teaching component that adds to the learning from work experience. The traditional radiography curriculum is considered to be an example of this. The relationship of work experience to higher education in radiography would be aligned to what Foster (1998) describes as work-experience placements of full-time students where there is a learning focus, such that the work experience is translated to work-based learning through the higher education institution involvement.

Activity Theory contributes to an understanding of the relationships and interplays of learning and work. Engeström (1987; 2001) derived Activity Theory from Vygotsky's (1978) introduction of the triad of subject, object, and mediational means. The theory was expanded to explain the difference between individual and collective activity (Engeström, 1987) and was then applied to new contexts of intersecting activity systems (Engeström, 2001). This is compatible with Castells (2000) description of the Network Society in which some social actors determine the rules by which the network will function and then impose the process on all actors within the network. To impact on the network, actors can either deny the network values or develop alternative networks of their own. Communication between networks is only possible if there are powerful actors who can act as decoders to translate the network knowledge between users.

Engeström (2001) integrates the theory of expansive learning, Actor Network Theory, Activity Theory, and the theory of cognitive trails, which includes the integration of the concept of boundary-crossing actions from Latour's (1987; 1996) Actor Network Theory, and Cussins' (1992) notion of stabilisation ('blackboxing') in cognitive trails. These concepts represent knowledge systems as partnerships in a variable network, requiring 'actors' to move across traditional boundaries, and a striving for stabilisation. Conceptualising learning as located in a heterogeneous framework of human and non-human actants is well suited to the health care environment with the interaction of practitioners, patients, the public, and equipment.

Billett (2000) proposes a way to understand the relationship between thinking, acting and learning that makes up knowing in the workplace. He uses the concept of 'knowing' to collectively express the process of concepts such as problem-solving, learning and transfer that must be applied in the workplace. He draws on Activity Theory to develop the concept of 'co-participation at work'. This partnership is the way in which the workplace makes participation in learning opportunities available, and the way in which each individual decides that they will participate. However, it is not sufficient merely to participate in the routine activities that are available as, for 'knowing' to be maximised, there should be learning opportunities in the workplace, and active guidance given by the workplace. For effective learning there need to be appropriate opportunities for learning within a caring environment of good role models, effective supervision, guidance with feedback and facilitation. These will also prevent the learning of inappropriate skills and attitudes (Cornford & Beven, 1999). The impact of students on workplace productivity must not be under-estimated; in particular, novice workers require time-consuming teaching and supervision (Cornford, 2000).

Overcoming differences in knowledge in higher education and the workplace

Higher education emphasises student learning; in work-integrated learning curricula this includes students learning through workplace practice. The literature on the socially constructed knowledge that arises through the relations of the persons participating in a process refers to working knowledge through work practice (Daly & Mjelde, 2000). This literature is useful in this research, even though much of it has to do with workplace learning that is not connected to higher education programmes. Daly & Mjelde (2000: 105) make the distinction between 'learning socially, inductively and in integrated processes somewhat different from individualistic, concept-oriented, deductive learning of the academic classroom'. They suggest ways of bridging the gap between learning process through active participation and text-oriented, theoretical knowledge in order to meet the needs of the modern workplace. This implies closing the gap between the academic and the strictly vocational, as working knowledge is elevated from its status of being inferior to academic knowledge.

Traditional workplace learning is based on the acquisition of competence that uses the discourse of 'stages' and 'levels', presenting a clear idea of what the practitioner should know and be able to do. Engeström, Engeström & Karkkainen (1995) point out that the workplace is changing in ways that require people to move between networks of parallel activity contexts, and this demands horizontal movement and boundary crossing by the practitioners in the workplace. Others use the metaphor of 'T-shaped' people to describe what is needed for the modern workplace:

> 'Industry seeks 'T-shaped people', in which the down-stroke represents depth and specialist knowledge in a discipline and the cross-stroke represents breadth and flexibility' (European Science Foundation, 2002).

Research on generic competencies concludes that workplaces enhance learning through having 'breadth as well as depth' (Holland and Leggett, 2000). They explain the breadth as the competencies that are generic to all workplaces and the depth as the professional knowledge specific to a particular workplace. Rip (2005) describes professionals a little differently by using the T-shaped metaphor. The down stroke representing the traditional disciplinary knowledge they need and the cross-stroke the experience-based knowledge of practice.

What is common to both work-based and work-integrated learning is that learning takes place in an authentic workplace through actual work. It is suggested that the term work-integrated learning describes a curriculum that has consciously been planned to ensure the integration of the formal teaching and learning such that the learning in the workplace happens through planned work experience to meet pre-determined outcomes. According to Smid (2000), this is the curriculum that emerges when higher education providers free themselves from the domination of the discipline-based programmes and develop new strategies to integrate learning and work.

Chappell (2000) talks of new knowledge discourses that construct knowledge as transient, performative and prone to becoming obsolete. This knowledge is not valued for its generalisability, consistency, certainty and location within the knowledge schema of existing disciplines, but rather is valued for its ability to maximize the benefits of social and economic systems. He argues that working knowledge gains status in this discourse, as it is performative, transdisciplinary and not governed by traditional epistemological classification. It is based in a context and therefore does not claim to be generalisable. Does this put the professional education programmes in a position where their knowledge base is now legitimised and valued? Possibly, yes; however, it remains the role of curriculum to cater for the existence of unstable practice knowledge that is constantly changing and being constructed.

2.1.4 Knowledge Production in Radiography

In the changing world, the existing links between a higher education programme and its related workplace may no longer be adequate. It is therefore essential that higher education is mindful of the need for curriculum renewal that is on a firm base of sound judgment and research. Negotiation for curriculum renewal takes place in sites of knowledge production that Nowotny terms 'transaction spaces' (Nowotny, Scott & Gibbons, 2001). These are actual or potential spaces where there can be negotiation or relationships between the worlds of higher education and work. These spaces facilitate the context of application 'talking back' to higher education and, more than that, allow the workplace to become actively involved in the education process. A productive transaction space is inevitably a strongly contextualized 'hybrid forum' where a diverse body of knowledge producers co-exist (Callon & Rip, 1992). Knowledge will change as it moves from one context to another, in order for it to be mobile and to be understood. The transformation of knowledge as it moves between higher education and the workplace is complex, and only when these translations are properly understood will they contribute to the development of effective professional curricula (Engel-Hills *et al.*, 2005).

The production of knowledge is changing in higher education institutions and in all organizations involved in developing knowledge (Gibbons, 1998). Gibbons *et al.* (1994) draw a distinction between two modes of knowledge production, which they term Mode 1 and Mode 2. In the traditional, disciplinary ethos of Mode 1, problems are identified and researched in a context controlled by the academic interests of higher education institutions. In Mode 2, knowledge is produced in a context of application and is transdisciplinary. In an evolutionary process, much of the research is now strategic research that is focused on problem-solving and the knowledge produced becomes diffused through society. This socially distributed knowledge is a shift away from academic knowledge to a structure of socially constructed knowledge. While Gibbons's distinction of Mode 1 and Mode 2 research might not be a reality, it is useful in providing a way of understanding the obvious changes that are taking place in knowledge and learning (Muller & Subotzky, 2001). Nowotny, Scott & Gibbons (2001) extended the Gibbons' thesis and described a 'Mode 2 society' where differentiation is replaced with integration.

Radiographers are increasingly interested in developing knowledge within their discipline; thus there is an awakening of interest in research. Radiography practitioners could be called 'emerging researchers' who practise in an environment well suited to interdisciplinary and transdisciplinary problem-solving and applied research. This study could therefore be considered to be Mode 2 research on a curriculum designed to develop Mode 2 practitioners.

2.2 Curriculum development in Radiography

Given that there is a variety of understandings of what a curriculum is, this section of the literature review initially investigates definitions and curricular structures. It then considers the role of integrated curricula in general, and in the health sciences in particular. In discussing the radiography curriculum, for example, there is an assumption among educators and practitioners that 'integration' refers to the connectedness between academic and workplace competencies. There is, however, a range of other 'integrations' that are context and knowledge dependent and that need to be considered in relation to curricular integration.

2.2.1 A typology of higher education curricula

A curriculum is more than a syllabus. It is both a description of the knowledge contained in a course of study, and a planned programme of teaching, learning and assessment. A curriculum could therefore be seen as both a static description of knowledge and sequenced learning activities, which could be classroom-based, or located within a variety of other environments (Harden, 2001b). The curriculum will thus determine the conceptual structure and framework within which teaching, learning and assessment take place (Reser, 2000). Posner (1992) proposes five concurrent curricula within the process of teaching and learning (official, operational, hidden, null and extra curriculum); Barnett and Coate (2005) suggest three curricula 'moments' (knowing, acting and being); while Harden (2001c) proposes four components of curriculum content in medical education (declared, taught, learned and hidden curriculum). The following curricular types, with different emphases, will usually be understood in any educational programme:

Official curriculum

In higher education, disciplines, subject areas or knowledge fields determine the curriculum (Barnett & Coate, 2005). The official curriculum represents codified knowledge, which is usually documented in various ways in order that the academic and the student have a guide for what must be learned, how it should be taught and learned, and how assessment should take place. The official curriculum will tend to guide the evaluation of the academic, the student, and the programme itself. The official curriculum also gives control to those in charge of the knowledge field, namely subject or disciplinary experts (Posner, 1992). The official curriculum can also be considered as what is declared and available in documents (Harden, 2001c), or the 'curriculum-as-designed' (Barnett & Coate, 2005: 3). The national higher education policy and guiding documents, the institutional documents and the ILC documents that guide the academics and students are the official curriculum of the ILC.

Taught curriculum

Barnett and Coate (2005: 3) contrast the 'curriculum-in-action' with the 'curriculum-as-designed'; the former is the 'achievement of a task' that 'has to be brought off *in situ*'. The taught curriculum includes the local, *in situ*, teaching and assessment activities that are deemed necessary to achieve the official curriculum. It is therefore the process of programme facilitation as it actually occurs, which would vary according to the context, students, teachers, assessors and available expertise (Harden, 2001c & Posner, 1992). The actual ILC, to achieve the determined learner outcomes for the radiography programme can be viewed as the operational or taught curriculum.

Learned curriculum

This is a further element of curriculum; this is what is actually learned by the students (Harden, 2001c). Barnett and Coate (2005) refer to the 'curriculum-as-outcome'. The importance of the 'learned curriculum' is the rationale behind the introduction of learning-focussed (although not necessarily learner-centred) curricula: OBE, modularisation, benchmarking, standard setting, and so on. The need to make the curriculum 'attractive' to learners, has driven an approach to curriculum development described by Barnett and Coate (2005) as the 'curriculum-as-consumption', which focuses on the students as customers, education as a 'value-adding' process, resulting in the increased marketability of students. What was actually learned by each individual student participating in the ILC is different from the requirements of the official curriculum or the intention of the operational curriculum.

Hidden curriculum

Sociology of education describes the curriculum as socially 'reproductive' in order to explain why it benefits some (usually middle class) students and not others; or why working class students tend to end up in working class jobs (Wills, 1977). The 'hidden curriculum' is used as a shorthand term for socially and culturally reproductive curricula. In this regard the curriculum is a 'cultural' construct, as Becher and Trowler (2001) explain in their study of the boundaries and distinctions between academic disciplines and their associated practices. Harden (2001c) describes the hidden curriculum as 'informal learning' or learning by the student that is unrelated to what is intentionally taught. The hidden curriculum conveys messages about values, norms, and behaviours that are acceptable or unacceptable in the health sciences (Posner, 1992). An example is the notion of hierarchy in the health care team that degrades the status of radiographers. This is powerful informal or unintended learning by students that keeps radiography from developing into a fully valued profession.

Transformational curriculum

The role of higher education to 'empower' and transform lives has been the subject of debate and theorising, since Freire's (1970) critique of 'banking' education. Debates have become more complex, and have focused on the power differentials between teachers and students as reflected in curricula (Giroux & McLaren, 1994). There have been attempts to look at ways in which higher education curricula can have transformative, empowering effects, particularly on those previously excluded from higher education (Harvey & Knight, 1996).

Null curriculum

Posner (1992) suggests that there are inevitably facts, ideas, or concepts that are not taught, or not considered to be of sufficient importance, to be included in the 'official curriculum'. Changing contexts and changing knowledge fields will drive decisions around what to include/exclude from the curriculum. For example, in the radiography curriculum of the past, it might not have been important, to relate sociological and psychological approaches to relationships in the workplace. In the light of a changing professional context, with more interaction between radiographer, others in the health care team, community and the patient, inclusion is now recommended.

Extra curriculum

This is made up of all the planned experiences outside of the official subjects (Posner, 1992). It includes the broad, enrichment, which is traditionally associated with higher education; as well as the space from the pressing realties of learning programmes that is needed for intellectual development, the joy of learning, and the discovery of new interests and pursuits. The extra curriculum contributes to what Barnett and Coate (2005) term the 'liberal curriculum'

Elective curriculum

I would argue that there is yet another curriculum category that can be added to those described by Posner (1992), Harden (2001c), and Barnett & Coate (2005), namely the 'elective curriculum'. This curriculum was evident in the optional learning opportunities that student radiographers became involved in. It represents the students' deliberate choice to engage in formal, informal, or self-made learning opportunities. Such learning is additional but contributes to the formal programme and is elected by each individual through a selection process of personal choice.

Any programme of learning will inevitably reflect these different assumptions and approaches to curriculum in different degrees and ways. In the section which follows, I suggest an approach that foregrounds integration in the curriculum as contributory to the development of radiographic knowledge.

2.2.2 Curricular integration

Bernstein (Bernstein & Morais, 2001) theorises that learning is regulated through three main systems: curriculum, pedagogy, and assessment. The concepts of 'classification' and 'framing' explain how curricular, pedagogical, and assessment systems function. 'Classification' has to do with boundary strength, while the 'frame' has to do with the context in which learning occurs (Bernstein, 1975). Boundary strength or classification concerns the degree to which a particular discipline or subject area is insulated from other knowledge fields. Certain disciplines, such as those in the hard sciences, would tend to have strong boundaries, while others, such as those in the applied sciences, have weaker, more porous boundaries. The 'frame' regulates selection, sequencing, and other pedagogical choices, which are inevitably connected with the strength or weakness of the classification. Classification and framing are also ways in which to analyse how power and control are transmitted (Bernstein, 1996). Classification is the means by which power relations create, legitimise and reproduce boundaries between different categories, discourses and agents such that it defines an attribute between categories rather than a characteristic of the category itself. Where classification is strong the insulation between categories, discourses and agents is well defined and the educator claims autonomy and authority within secure boundaries. In environments of weakened classification, there are opportunities for practice in the discipline to be influenced from the outside. There may be 'recontextualisation' (Bernstein, 1996), where selected knowledge is relocated, for example from a place of practice, and translated into the educational context as a curriculum.

Framing refers to the selection, sequencing, communication, and pacing that transform the principles of control into interactional discursive practices. In weak framing, the pedagogic practice is inclined to be invisible and the acquirer has more apparent control, although the rules of regulative and instructional discourse are implicit and largely unknown to the acquirer. Classification and framing can vary independently to produce a variety of pedagogic practices. The analytic distinction between these two aspects of discourse in pedagogic interactions is described as the regulative discourse (social rules) governing selection in the curriculum and the curriculum design and the instructional discourse (content and skills) such that the latter is always embedded in the former (Bernstein, 1996).

Academics have particular choices in the way in which they choose to classify and frame subject areas within a curriculum. They might choose to build a curriculum with strong boundaries between subjects, where the disciplinary components of the curriculum remain insulated. Bernstein (1975) describes this as a 'collection-type' curriculum. On the other hand, educators may choose to bring together disciplinary components in a planned way, for example through identifying themes or problems that cut across disciplinary or subject areas. Bernstein (1975) describes this as an 'integrated-type' curriculum.

While 'collection-type' curricular have, as it were, built-in, authoritative frameworks in which teaching, learning and assessment can occur, integrated curricula require skilled educators and curriculum experts to build coherent frameworks for students' intellectual development. The lack of such skills can lead to the failure of integrated curricula, and is a potential disadvantage of integration. Bernstein (1975) suggests that there are five conditions that must be complied with for integrated codes to be successful: there must be approximate consensus about the integrating theme; this idea or theme must be made explicit; the connections between the theme and the contributing content must be systematically and coherently processed; there must be a committee system of educator and learner to manage the learning environment sensitively; and there must be clear and transparent assessment criteria.

The integrated curriculum is not a new idea. Over the years this form of teaching and learning has received much attention in educational settings from the primary levels through to higher education. Lake's (2003) review article, although referring to the school curriculum from Kindergarten to Grade 12, offers a useful overview of curricular integration. According to Lake (2003), there can be no single definition of curriculum integration, as one definition would not adequately describe the complex variations that are possible within the concept of integration. There are, therefore, many terms that relate to integration, including interdisciplinary, thematic and synergistic teaching. Further approaches such as community-based, problem-based and guided discovery learning programmes (Reser, 2000) are also described as integrated. Thus, while these terms all describe different educational approaches, they can in part all be described as 'integrated'. All are introduced as educational innovations with the goal of fostering student centred, active learning (Moust, Berkel & Schmidt, 2004). Through a process of considering definitions of integrated curriculum, Lake (2003) suggests that this approach prepares the learner for life and for life long learning. How we learn and what we learn impact on us as life long learners (Haslett, 2001) and these aspects are therefore important considerations for the radiography curriculum in present day South Africa. The integration of generic competencies, the clinical world, as well as life long learning, are a national imperative and key to the health care of the public whom we serve.

2.2.3 Curricular integration in the health sciences

The College of Medicine at the University of Vermont (2003) identified three important integrations in the medical education. The first is the integration of basic and clinical science, where what is stressed is the integration of concepts. This integration does not mean that the clinician or basic scientist has to teach the other's concepts, but rather that the design of the learning experience encourages conceptual integration in order to achieve the curricular goal of educating doctors with the skills and motivation to continually access basic science knowledge. A similar example is the integration of pharmacology modules with other basic and clinical sciences (Dunaway & Faingold, 2001). The second integration concerns interdisciplinary teaching, as opposed to traditional discipline-based teaching. The third integration requires collaboration among healthcare practitioners.

In the context of medical education, Harden (2000) describes eleven points of integration on a continuum between the extremes of no integration and full integration. Fogarty (1991) describes ten levels on a continuum of integration. These approaches are compared in Table 2.1. The general trend of the continuum is towards more integration, although as Reser (2000) points out, Harden's (2000) continuum may not be as hierarchical as it is presented, and that there might be more integration within lower levels. This is also true for the Fogarty continuum.

Khan (1995) defines four general approaches to the integration of capability-based education for environmental sustainability within professional education and makes it clear that this is dependent on the underlying assumptions of the disciplinary professional educators involved. These approaches are pertinent to the integration of other topics within health science programmes and are therefore presented in Table 2.2 in a broader way, rather than limited to environmental sustainability.

Table 2.1: A comparative continuum for curriculum integration

11 Steps for integration (Harden, 2000)	**Explanation**	**10 Views for integrating** (Fogarty, 1991)
	Learner filters learning via the expert's lens, personal connections result in external networks of experts in related fields	**Networked**
	Disciplines are part of learner's lens of expertise and the learner becomes immersed in a personal learning experience	**Immersed**
Trans-disciplinary	The field of knowledge is the focus as the curriculum transcends disciplines and the disciplines are part of the real world experience	
Inter-disciplinary	Themes as the focus with no reference to individual subjects or disciplines	**Integrated**
	A Metacurricular approach threads thinking, social and study skills as well as technology and multiple intelligences through the various disciplines	**Threaded**
Multi-disciplinary	A theme is used to connect the concepts, topics and ideas in each subject as the theme or problem is viewed through the lens of the subjects/disciplines	**Webbed**
Complementary	Theme based integrated teaching sessions supported by subject based teaching	
Correlation	Subject based teaching with regular integrated teaching sessions	
Sharing	Joint planning and teaching to produce shared concepts, skills and attitudes in two or more disciplines	**Shared**
Temporal coordination	Coordination of topics examined from different perspectives such that similar ideas are taught to coincide within the separate subjects	**Sequenced**
	Multiple skills; social, thinking and content specific skill within each subject	**Nested**
Nesting	Content drawn from different subjects to enrich the teaching	
Harmonisation	Consultative planning achieves connections between subjects that are separately taught	**Connected**
Awareness	Subject based teaching and assessment but with communication between academics	
Isolation	Subject based teaching and assessment	**Fragmented**

Table 2.2: Khan's (1995) four approaches, adjusted for the integration of an agenda/problem/topic into professional education and practice.

Curriculum Approach	Curriculum Activity	Impact on Profession
Addition	Assumes the topic has little relevance to the profession and so deals with the topic in a way that separates it from what is perceived as the real learning agenda.	Profession remains unaffected by any challenges that are posed by the topic.
Incorporation	Assumes the topic has some relevance to the profession but starts from the existing professional preoccupations from which connections to the topic may be made.	Profession is influenced to revise some established theories and practices in an evolutionary manner.
Limited Engagement	Assumes the profession has something to offer to the topic and so starts from the problem to which the profession may make a contribution.	There is interdisciplinary or interprofessional engagement to define complex problems and find complete solutions.
Full Engagement	Assumes the profession has a key role to play in the topic and starts from a vision of a full and active part in the topic.	Professional education and practice critically redefines itself within the context of the topic/agenda.

2.2.4 Why should there be curricular integration in the health sciences?

The knowledge that is necessary in the world of work is '*the integration of ideas and experience*' (Walshok, 1995). Research indicates that the brain may resist learning facts that are presented in isolation (Caine and Caine, 1991) and this indicates a potential advantage from the use of educational methodologies such as interdisciplinary learning, experiential education and learning in an authentic context. Curriculum integration is a way of facilitating understanding, making education more meaningful and promoting knowledge transfer (Perkins, 1991).

The ability to transfer learning from the context of learning to a new context is critical for radiography students. Qualified radiography practitioners continually transfer knowledge and skills from one context to another in order to cope with the demands of their profession (Lauder, Reynolds & Angus, 1999). In radiography, learning should happen in a way that facilitates the acquisition of skills needed for successful knowledge transfer. But, as with nursing, there is some doubt as to whether the process of the transfer of knowledge for satisfactory implementation in the clinical setting is consistently achieved (Phillips *et al.*, 1998).

The practical nature of the health sciences demands that the practitioner is able to appreciate the relationships between subject areas in order to use all relevant information in a connected way. The skill of fitting things together cannot be assumed. Humphreys (1981) suggests that if we teach separation and discontinuity, that is what is learned, while if we want connectedness and integration then that is what we must teach. Integrated curriculum design therefore contributes to the facilitation of appropriate learning for professional practice. Lipson's (1993) work supports the use of an integrated curriculum because it helps students apply skills, provides an integrated knowledge base that leads to faster retrieval of information, encourages depth and breadth in learning, promotes positive attitudes in students, provides for more quality time for curriculum explorations, and uses multiple perspectives that lead to a more integrated knowledge base. There are also suggestions that integration through inter-professional education enhances the useful learning of health care practitioners (Kedge, 2001).

The reasons for the interest in curriculum integration are many and include these: the growing body of knowledge; an increase in state demands for higher education; concerns about curriculum relevance; global interdependence; increase in the pace and complexity of life; and the separation of disciplines in a world that needs workers to be able to solve problems that involve interrelated factors (Jacob, 1989; Benjamin, 1989). This is not to imply that knowledge, particularly disciplinary knowledge, is no longer relevant. What it does point to is the tendency of higher education to move away from teaching an ever-increasing volume of isolated facts toward a more constructivist view of learning that values understanding and in-depth knowledge of learning areas. This view finds its basis in the work of Piaget (1977), Dewey (1964), Bruner (1986) and others who view learning holistically. The integrated curriculum is an example of such a move away from rote learning to an appreciation of concepts and relationships between concepts, which will allow the flexible use of knowledge and insight (Lake, 2003).

Students appear to respond positively to a curriculum that is directly relevant to the workplace and favour courses that include practical skills (Wissenschaftsforum Bildung und Gesellschaft, 1998). The concept of 'cognitive trails' (Cussins, 1992), as a way of tracking student progress, indicates that the trails are context dependent, and that the person learns to function in the environment by moving into and around that environment. Health care practitioners, who have traditionally developed curricula that place students in the clinical environment from early on in the programme, understand this. The tension in this is that the students gain expertise in the working knowledge of their profession, while still unformed in the academic knowledge bases of the profession. This is similar to the teacher/learners described by Chappell (2000), who mentions curriculum strategies such as competency statements, outcomes, holistic assessment practices, and problem-based learning that attempt to overcome this contradiction. The integrated curriculum, in various forms, is a viable option in the health sciences where there is a need to have practice built on a body of knowledge. Much of the curriculum change in the health sciences has involved various forms of integration, in 2001 for example, the Association of Japanese Medical Colleges showed that a small number of medical schools (9%) had adopted an integrated organ-system-based curriculum (Saito, 2002); while, in the same year, a survey by the undergraduate curriculum committee of the Japan Society for Medical Education indicated that 48% of the medical schools had implemented some form of problem-based learning (Kozu, 2002). The authors, Onishi and Yoshida (2004), mention that many of the problem-based learning curricula in Japan are hybrid forms as there is still a debate between the value of discipline-based and organ-system-based curricula. In the worldwide debate on problem-based learning, some are of the opinion that it should be abandoned while others propose a closer look at the teaching-learning process in problem-based learning before discarding what is potentially a good curriculum model for health sciences (Miflin, 2004).

2.3 The implementation of integrated curricula

All curricula are contextual, particularly in terms of resources (human, infrastructural, financial). It is therefore necessary to consider localised implementation issues in a broad sense in order to gain understanding of how integrated curricular might be realised within a specific context.

2.3.1 Operational and strategic issues for curriculum

The goals of the education programme should be clearly expressed, although, as Barnett and Coate (2005) point out, talk of 'aims' and 'objectives' can be misleading for they may encourage 'a sense of sequentialism involved in aiming at a target; once one has let go the arrow there's no further action' (2005: 45). Explicitly expressing the goals of the curriculum through outcomes is, of course, not the end of curricular responsibility (Crosby, 2001). OBE is the expression of the goals of education, and specifies the outcomes that students should be able to demonstrate on qualification. This puts the emphasis on what the student can do rather than on what the teacher teaches. However, this is not merely the mastery of tasks but must include competency to transfer learning to new contexts and achieve independence as a life long learner (Fitzpatrick, 1991).

The findings of the investigation by the European-based, Wissenschaftsforum Bildung und Gesellschaft (WIFO), on integrated curricula within an outcomes structure can be used to guide implementation (Wissenschaftsforum Bildung und Gesellschaft, 1998). Some of the findings were that in Finland the move towards study through programmes has been gradual and Germany has found that theory and practice are complementary when students learn by doing. The integrated curriculum in France has led to the introduction of innovative teaching methods. England/Wales is an example of units of learning expressed as outcomes where the students are assessed against specified criteria and performance is judged by means of a portfolio of evidence. In a similar way, Norway's guidelines for reform include establishing a core curriculum, developing learning objectives, preparation of a learner's guide to encourage active participation, compulsory project work, and a portfolio of evidence. One of the problems with implementing these integrated curricula was that, in some cases, teachers started with collaborative planning, then taught their own subjects individually. Opinions on the benefits of integrated curricula were obtained through teacher interviews. Perceived benefits were a reduction in formal lecturing, a reduction in disciplinary problems, and an improvement in students' ability to communicate with peers, teachers, and workplace colleagues. An important finding in England was the development of assessment with synoptic dimensions to promote 'higher order' skills (Bloom, 1956). These included analysis, synthesis, evaluation through the assessment of accumulated understanding of the domain as a whole, the ability to integrate and transfer cognitive knowledge and skills, and demonstrate understanding in relevant contexts of application.

In a study of an integrated curriculum, Moust, Berkel & Schmidt (2004) conclude that problem-based learning is a coherent educational approach. They describe problem-based learning as an example of a multidisciplinary, integrated curriculum that is designed so that subject matter and skills are integrated around a central problem or theme. The learning environment comprises small groups, who are facilitated by a tutor. This promotes self-directed and independent learners through active, constructive, contextual, cooperative and goal-directed learning.

A further operational issue is the recognition of the importance of skilled educators in the education of health care professionals. Because of the changing context and the need for curriculum innovation and reform, Dent (2001) stresses the need for academic staff development. He also identifies the provision of adequate support structures for students as a success indicator in curriculum implementation.

The key element in integrated curricula appears to be the essential role of cooperation between the education institutions and the workplace as well as functional cooperation between the academics in the education institution and the educators or trainers in the workplaces that the students attend (Wissenschaftsforum Bildung und Gesellschaft, 1998).

2.4 Conditions for an integrated curriculum for Radiography

In planning a programme of learning for future radiographers, we need to consider what would contribute to worthy learning experiences. Shoemaker (1989) proposes some essential components for the successful development of an integrated curriculum. These can be adapted for an integrated curriculum in radiography as follows:

1) Generic competencies such as scientific writing, problem-solving and professionalism are integrated.
2) Curriculum learning areas, themes or topics as the organizing structure.
3) Unit development of learning activities is planned to lead to identified knowledge development.
4) Assessment in line with the curriculum design to monitor student progress (Wiggens, 1995).
5) Evaluation of the integrated curriculum through formal and informal processes.

A comparative study conducted with 225, second year occupational therapy students at six higher education institutions in the United Kingdom classified programmes as problem-based, subject-based or hybrid. The problem-based programmes were associated with higher scores, as far as appropriate assessment and emphasis on independence was concerned. The responses showed problem-based curricula were associated with lower scores for reproducing orientation and higher scores for a deep approach. The findings suggest that a problem-based curriculum affects the quality of learning in a positive way; this can partly be attributed to the students' perceptions of the learning environment (Sadlo & Richardson, 2003). If a goal of the curriculum is for students to actively construct their own knowledge and practice using new skills and concepts, a study that measured student engagement in 56 university classes found that students participate more, and also express more understanding of course concepts in a learning environment that actively engages them, and when there are fewer students in the class. Problem-based learning was found to lead to a high level of participation (Ahlfeldt, Mehta & Sellnow, 2005). Another study based on student responses at Southern Illinois University School of Medicine found that, when pharmacology was integrated with other basic and clinical science disciplines, there were learning gains, a high level of enthusiasm and student participation (Dunaway & Faingold, 2001). In this example of an integrated curriculum, the authors stress that the specific learning outcomes that are essential, and that each discipline must receive appropriate emphasis within the integrated curriculum. They continue with steps and requirements for the development of multidisciplinary, integrated sessions and discuss the need for the academic team to be multidisciplinary and representative of the basic and clinical sciences. In a review of the factors that contributed to the success of integrated sessions, they showed that the faculty should have enthusiasm and interest in developing and sustaining an integrated curriculum, as well as be knowledgeable, creative and cooperative; and that the support of the programme leader was a key element.

The criteria for successful integration from WIFO (Wissenschaftsforum Bildung und Gesellschaft, 1998), Dunaway and Faingold (2001), and McLean (2004) are summarised below. Such a curriculum would comprise:

- A collaborative academic team that is representative and cooperative.
- Dedicated educators who take ultimate responsibility for teaching and learning.
- Educational institutions and workplace/s that cooperate functionally.

- Students who know that their experience and evaluation of the curriculum will impact heavily on those who follow.
- Appropriate rules and policies for students and staff for curriculum reform.
- An innovative curriculum with integrated and self-directed learning processes.
- A flexible curriculum design that incorporates the use of a variety of new teaching and learning experiences.
- An active learning environment with the academic as facilitator and an emphasis on the development of students as independent learners.

Such a curriculum would also:

- Minimize perceptions of bias by being as inclusive as possible of all disciplines.
- Eliminate redundancy of information presented.
- Establish a consistent terminology spanning all the disciplines to reduce confusion.
- Present information in an order that facilitates the structured acquisition and integration of the student's knowledge base.
- Develop personal competence in a complex and active way.
- Assign a high priority to assessment practices and review their appropriateness regularly (Wiggens, 1995), with awareness that assessment drives learning.
- Develop a schedule that prevents overload and facilitates full participation by both students and academics.
- Plan for curriculum review and evaluation but be aware of over-burdening the students.
- Communicate the progress of curriculum reform to sustain enthusiasm and attend to the variations between the negotiated and actually implemented curriculum.

- Reward commitment to curriculum development and encourage research, as it is the efforts of the dedicated few that sustain continuous curriculum innovation.

A study at Maastricht University identified ideas that may help academics to revitalize the problem-based learning process (Moust, Berkel & Schmidt, 2004). These have some similarity to the criteria listed above, but with the difference that their ideas are focussed on the student. These can also be viewed as useful criteria for an integrated curriculum. Academics should:

- Build teaching communities to overcome the sense of anonymity in large groups of students and to ground the innovation in daily practice.
- Inform students about the ideas underlying the curriculum intention and the positive effect it will have on their learning and growth as professionals.
- Guide students to become self-directed learners through a gradual transfer of control over thinking and learning processes that develops independent and life long learners.
- Have a varied learning environment that fosters students' and academics' motivation.
- Develop computer-supported learning for individualized authentic environment.
- Adopt new forms of assessment (Perrone, 1988; Engel, 1994), that reward behaving as a professional and promote good study behaviour

Many of the above criteria can be categorised as 'reflective practice' and 'life long learning'. These are discussed below.

2.4.1 Reflective practice

The concept of looking forward and anticipating what action is needed, knowing why it is needed, and understanding what the outcome will be can be thought of as reflective practice or anticipative action (Beckett, 2000). Radiographic practice is a process of thoughtful, rather than automated, action. It is not about doing faultlessly but thinking about what you are doing, as each time is a little different and needs thought as well as skill: knowing and acting. Reflective practitioners are reflective and anticipate the need, rather than being merely skilled technicians. They must, according to Beckett (2000), learn in authentic work places, with real problems to solve, and in a team of real peers. A simulated workplace is inadequate and does not develop reflective practice.

Hirsch's (2000a) 'think tank' methodology is a means of overcoming the gap between research and practice by making the space for practitioners to conduct research that is based in their practice. Through reflection, interpretation, and analysis, 'Reflective practitioners' (Schön, 1983) develop knowledge on issues that are of interest and value to them. The gap between researchers generating theory from theory, and practitioners who operate from their own experience and practical knowledge (Jarvis, 1999b), is minimized through 'active reflection' (Schön, 1983, 1987; 1995), where practitioners reflect on their practice. This is considered critical for both the higher education and clinical practitioners in radiography to allow their tacit knowing to be made explicit and, through that, researchable. The reflective practitioner can become the reflective researcher who generates knowledge connected to the dynamic experience of the real world situation (Hirsch, 2000a). Practitioners who have the skills of reflective practice will also be able to enjoy the benefits of being life long learners (Holland & Leggett, 2000).

2.4.2 Generic competencies and life long learning

Competent practice requires more that 'entry level' knowledge and skills. Radiographers need to continue learning, and to transfer knowledge from one context to another. This is facilitated through the acquisition of generic competencies that have become a focus in higher education (Holland & Legget, 2000; Whittle & Murdoch-Eaton, 2004). The generic competencies for life long learning must be built onto a sound knowledge base that supports abilities for inquiry and discovery (Hirsch, 2000b). Those abilities that are emerging as the most important are self-directed learning, problem-solving and critical thinking (Dent, 2001).

In the United Kingdom, a study of 460 first year medical students investigated the transferable skills that students enter the university with. It showed that, while most students had opportunities to acquire generic competencies during their school years, there were a significant number of students who did not have adequate opportunities for developing all of these skills. Computer skills is an area where many students were inexperienced. The two other weaknesses were the use of the library for research and essay writing (Whittle & Murdoch-Eaton, 2004). This indicates that universities must continue to take responsibility for enabling the acquisition of generic competencies in order to facilitate independent and life long learning. In the medical radiation sciences (radiography) in Australia, a national study on life long learning showed a discrepancy between higher education and workplace culture (Sim, Zadnik & Radloff, 2003). While higher education institutions are supportive of life long learning in terms of course objectives, teaching approaches and assessment methods, in general the workplace was not supportive. This was shown by the failure of workplaces to provide a supportive learning environment, inadequate support for research initiatives and the exclusion of life long learning attributes from the job selection criteria for new graduates entering the workplace. This demonstrates the need for a collaborative transformation of the workplace so that, while higher education institutions strive to develop students for life long learning, the students will regard generic competencies as relevant to their future employability, unless the workplace functions within a life long learning culture. Billett's (1999) concept of co-participation for knowing or learning through work further supports this. Individuals cannot take sole responsibility for maintaining their professional currency. Each radiographer will need an environment of co-participation to succeed in growing continuously as a practitioner and person. In the rapidly changing workplace, radiographers will need to maintain professional knowledge currency in order to remain employable, and to deliver a high level of patient service and care. Our students must learn how to learn, and have the skills to go on learning throughout their working life (Cornford, 2000).

2.5 Why an integrated curriculum would suit Radiography

Lauder, Reynolds & Angus (1999: 483) are of the opinion that there is inadequate research to know 'what combination of factors, for what type of person, engaged in what type of activity are least likely to promote effective transfer'. This section will contribute to the academic debate and knowledge production around some of these important issues by exploring what goals are served through an integrated curriculum.

2.5.1 Curriculum integration and the changing world

In a commissioned literature review to identify recent and predicted changes in health care services that impact on nursing, and to identify the skill and knowledge nurses require to respond to these changes, the most important change was attributed to healthcare as a commodity (Aitken *et al.*, 2001). The authors liken healthcare services to a scarce commodity where demand exceeds supply so that there is a need for innovative dynamic organisation and re-organisation, such as the move away from institutionalised care to models of local community care in order to provide care for an aging population. Other changes in the health care environment include such elements as: a rapidly increasing knowledge base in the information age; the need for multi-professional cooperation; the recognition of the importance of primary health care; well informed patients who require a shared decision making process; the promotion of best evidence medicine; health promotion and disease prevention as a priority; and a diverse student body (Dent, 2001; Aitken *et al.*, 2001). Therefore the health care professional needs current knowledge and competency as well as appropriate attitudes and behaviour to practise as effective practitioners whose roles are both expanding to be more generalist and extending to become more specialised (Aitken *et al.*, 2001).

A curriculum for the education of students in the health sciences must reflect the changes that are taking place in health care, education, and scientific and technological advances (University of Vermont, College of Medicine, 2003). In the changing context of radiography in South Africa, there is a need for curriculum change so that the curriculum caters for the future needs of the learner who as a practitioner must practise for the benefit of the patient and public. To achieve this there are radical and moderate approaches to curriculum renewal to overcome the rigid and non-creative education of traditional institutions, irrelevant for the context in which health care practitioners practise today. As a curriculum is delivered within a unique context, there must be a decision on what will work best for that specific environment. It is unsatisfactory to adopt a curriculum from elsewhere and Posner (1992), suggests that curriculum decision makers can use reflective eclecticism to deal with the multitude of options available to them, and to implement a curriculum that is an adaptation to suit the context.

It is possible that educational reform has resulted in subtle, rather than significant, change in the classroom (Carnoy & Rhoten, 2002). Perhaps these subtle changes are important within the bigger context of change. One such change is the shift of the lecturer from the position of classroom instructor, lecturing from a pre-determined syllabus, to being a facilitator in a student-centred knowledge-producing environment (Monkman & Baird, 2002).

2.5.2 The integrated curriculum in practice

In European countries, in a comparative investigation of qualifications with a dual orientation towards employment and higher education that were developed with the concept of achieving parity of status between work-based and knowledge-based learning, the linking of vocational and general education was found to range from additive to integrative approaches (Wissenschaftsforum Bildung und Gesellschaft, 1998). In Bavaria it was found that students discover knowledge in authentic contexts, and that there is considerable learning potential in learning-on-the-job. In Brandenburg, the student's ability to work independently and responsibly was encouraged and developed through integration. In a Norwegian study, it was recommended that, in order to overcome poor motivation of learners, the teachers should contextualise the content (Wissenschaftsforum Bildung und Gesellschaft, 1998).

The 'SPICES' model describes the different educational strategies used in medical schools throughout the world (Harden, Snowden & Dunn, 1984). The acronym is derived from: Student-centred (versus teacher-centred), Problem-based (versus information gathering), Integrated (versus discipline-based), Community-based (versus hospital-based), Electives (versus standard programmes), Systematic (versus apprenticeship-based). It is possible to measure SPICES in any curriculum, albeit without assurance that a higher SPICES score is indicative of a better curriculum for the education of practitioners in the health sciences. Indeed, as one of the SPICES authors points out, there is no consensus in health science education about whether the education strategy should be discipline-based or integrated (Harden, 2001b). There are, however, a variety of innovative educational strategies that are appropriate for learning in the modern world and that replace rote learning and regurgitation of information. However, the facilitation of learning is likely to be more difficult in these contexts than traditional lecturing and is therefore not an easy option (Dent, 2001). The integrated teaching and learning sessions were found to demand commitment from the academic staff due to the amount of time needed for development and maintenance. In addition, the facilitators involved needed good leadership skills (Dunaway & Faingold, 2001). There may not be consensus or clear direction, but the literature does imply that there is no turning back from strategies such as problem-based, task-based, community-based, self-directed, integrated and multi-professional learning or the elective-driven curriculum and systems approach to teaching and learning, as these suit the education of health care practitioners (Dent, 2001; Harden, 2001b).

To assist with the implementation of an integrated curriculum, there is guidance on factors that contribute to successful curriculum however the real challenge in curriculum reform is sustaining the change (Robins, White & Fantone, 2000). After 30 years of problem-based learning and research at Maastricht University these authors present findings on the learning processes of students, their study behaviour and the amount of time they spent on self-study. Researchers found that the original ideas underlying problem-based learning had been eroded to some extent. Some changes linked to the processing of information in tutorial groups were these: self-study time had dropped steadily over a five year period; preparation for the tutorial group was approached in a minimalist way; time spent on looking for information on a problem dropped; and there was an increasing tendency for students to use the same resources and not engage in restructuring their knowledge on the basis of new information. Other changes were due to inadequate student-staff ratios, because of the negative impact of an increasing number of students in the tutorial groups and the use of students as group facilitators. There were also changes caused by the fear that subject content was not adequately covered through the problem-based curriculum. This led to practices such as reverting to the lecture mode, or giving a short list of specific references, which meant that most group members studied the same resources. In consequence, the group sessions tended to be more content-driven than process-oriented; and the role of the lecturer gradually reverted from that of a facilitator who motivates and guides student learning to simply that of a conveyer of information. The researchers were able to offer suggestions on how to correct the erosion of good curriculum intentions. Their closing argument is that curriculum reform is not a single event, but must be continuously renewed (Robins, Whit & Fantone, 2000). There needs to be a continuous cycle of curriculum reform and innovation to prevent educators slipping back to the practices of the past.

2.6 Summary of main points in the literature

The issues that are mentioned in the literature have focussed on the aspects relevant to this study of a radiographic curriculum, but have also contributed to a broader framework for higher education curricula in the modern world. The salient points are now summarised to capture the most important aspects from the literature before proceeding to the following chapters.

Radiography could benefit from a curriculum free of the domination of discipline-based programmes and with new strategies to integrate learning and work (Smid, 2000). Such a curriculum requires strategic cooperation between the academy and the workplace as well as functional cooperation between the academics in higher education and those who teach or train in the workplace (Wissenschaftsforum Bildung und Gesellschaft, 1998). The dynamic curriculum must be designed and implemented to meet the needs of a constantly changing environment through addressing what Bernstein (1999) refers to as the relatively inflexible vertical knowledge of a specialist community and the changeable horizontal knowledge typical of the workplace. The integration of generic competencies that develop independent learners with the ability and desire for life long learning and professional knowledge needed for radiography practice is central to the concept of an integrated curriculum in radiography.

Curricular integration in Radiography has the potential to encourage a high level of participation, and enable students to actively construct their own knowledge and competence in order to promote knowledge transfer while maintaining specific learning outcomes essential to the individual disciplines (Dunaway & Faingold, 2001). Acquiring integrated and structured knowledge through learning experiences with direct clinical relevance facilitates professional development by providing a knowledge base for rational problem-solving that allows good clinical reasoning (Dunaway & Faingold, 2001). Beckett's (2000) guidelines for developing a reflective practitioner are appropriate for the education of radiographers in that there is integration of authentic workplaces with real problems to solve by a team of peers.

There are many variations of curriculum that are described as integrated. These include work-related learning, work-based learning, work-integrated learning, interdisciplinary, thematic and synergistic teaching, community-based, guided discovery learning programmes, problem-based learning and a multitude of hybrids. Each of these has something to offer in the understanding of integration. Fogarty (1991) and Harden (2000) describe a theoretical continuum of integration, which is an important reference for locating different types of curriculum.

The implementation of an integrated curriculum is not without some disadvantages, and these need to be considered for a full understanding of this strategy for higher education. Then there is the matter of reverting to the old ways: teachers who start by planning together, but still teach their own subject individually and revert to the lecture mode (Wissenschaftsforum Bildung und Gesellschaft, 1998). Ultimately, it is likely that the most important aspect for the success of an integrated curriculum is the presence of skilled educators (Dent, 2001). The way forward is a continuous cycle of curriculum renewal, innovation and research to fill the knowledge gap on integrated curriculum.

3. A methodology for researching a radiographic curriculum

> Thus, curriculum analysis is more like detective work than clerical work, more like literary analysis than taking stock inventory. Once you learn how to do a thorough and complete analysis, you will find that you have internalised a basic sense of the enterprise and even some of the steps. Once the process becomes second nature to you, you will be able to perform an adequate informal analysis in an hour or less (Posner, 1992: 23).

3.1 Approaches to curriculum research

Curriculum research has, traditionally, been limited to quantitative studies of students' academic performance, in the expectation that quantifiable information (such as how many students attend, pass, or fail courses) will provide a reliable research base for the development of new, or the enhancement of existing, curricula. Traditional curriculum research that foregrounds goals, objectives, scope and sequence charts, and prescriptive evaluation instruments with an emphasis on curriculum as an object (rather than a process) has been critiqued (Eisner, 1997; Giroux, 1992). Post-positivist critique of traditional curriculum research is founded on incredulity toward 'metanarratives' (Lyotard, 1989), rational enlightenment thinking, and other efforts to create unified explanations of reality (Doll, 1993).

Post-positivist approaches to curriculum research require multiple voices, contextual reflection, and expanded illustrations. Post-positivist curriculum research is founded on the following understandings:

- Curriculum research is an emerging process of understanding the complexity of the interrelationship between parts and the whole, with an emphasis on the engagement of the individual within a holistic framework, rather than an emphasis on the transmission of isolated elements of inert information (Barnett & Coate, 2005).
- Curriculum research is a 'multi-vocal' process involving many interest groups (Usher and Edwards, 1994).

- Curriculum research is an attempt to study the null and hidden dimensions of the curriculum – and not just the obvious 'official' curriculum (Eisner, 1997; Giroux, 1992).
- Curriculum research involves a commitment to ethical concerns (Slattery, 1995).
- Curriculum research involves a phenomenological approach to the investigation of the lived world experience of teachers and students (Aoki, 1992; Greene, 1995).
- Curriculum research is founded on the belief that educational researchers are able to improve the lives of those they study (Lather, 1986).
- Curriculum research necessitates collaborative practices (Daly & Cobb, 1989).
- Curriculum research is founded on a strong belief in the futuristic dimension of teaching and learning that requires bold initiatives to address social, political, economic, racial, and gender issues in the educational process (Slattery, 1995).
- Curriculum research acknowledges the centrality of narrative and autobiography in the research process where curriculum development does not make sense outside of a reflective context of curriculum understanding (Pinar *et al.*, 1995).

3.2 Research Design

The following research questions guided the research design:

1) What is the nature of radiographic knowledge?
2) What curricular options would facilitate radiographic knowledge?
3) What would enable or constrain successful curriculum implementation?
4) Is the ILC an appropriate curriculum for Radiography?

This study, a post-positivist curriculum research project, made use of a multi-method, multi-vocal approach to include the voices of student radiographers (students), radiography educator practitioners (academics) and clinical radiography practitioners (practitioners), who were able to bring their own agendas, expectations, concerns, ideologies, and perspectives into the curriculum research process. The research design therefore generated data on radiography education generally, as well as data specific to a particular curriculum intervention.

3.2.1 National Survey

A national survey of students, academics and practitioners was conducted. The author developed the survey tool, a questionnaire (Annexure B). This survey primarily contributed to answering research question 1 on the nature of radiographic knowledge.

Surveys are generally weak on validity but strong on reliability (Babbie & Mouton, 2001). Aspects of the survey were used to locate and support the findings of the case study of an integrated curriculum in radiography.

Delimitations of the national survey

The survey is delimited to higher education institutions in South Africa that offer a basic radiography qualification: a 3-year diploma or a 3-year undergraduate degree; and associated clinical radiography sites where students obtain clinical experience. The data gathered were from three identifiable respondent groups: students, academics and practitioners in radiography.

Selection criteria

Eight higher education institutions, including five Technikons, two Universities and one Institute of Technology, were the South African institutions where radiography was offered at the time of the survey. Due to mergers and restructuring of higher education, one institution had merged and initiated transformation to an institute of technology, prior to the survey. All other institutions are now in the process of transforming into a University of

Technology (previously a Technikon) or a comprehensive university (merge of a Technikon and a University). However, all eight radiography departments are still in existence within the changing landscape of higher education. In 2003, all were approached to participate in the survey and five agreed, including the local institution. At each institution an academic was purposively selected (Uys & Basson, 2000) and multiple copies of the questionnaire were sent to them. They, in turn, issued questionnaires to academics, practitioners and students connected to their institution. These respondents were to be willing participants, able to complete the questionnaire.

The questionnaire was voluntary and self-administered. Individual respondents returned completed questionnaires directly to the researcher in postage paid envelopes. Biographical details regarding years of experience, higher education institution, radiography category and clinical facility were used to monitor the returns but these were not used as categories of analysis. As the purpose was to gain an impression of the national perspective, all questionnaires for each of the three participant groups were considered as a group. Information on the number of questionnaires given to students, academics and practitioners was not available for all institutions, therefore the return rate could not be calculated for the three groups individually, except at the local institution. The overall return rate was 44%. However, there was an 81% return for the local institution (students: 97%; academics: 36%; practitioners: 29%) and a 26% return from other institutions.

A sub-set of seventy-three student radiographers from the survey participants was isolated and separately analysed. These were students on the radiography programme at the site of the ILC and will be discussed as contributing to the data of the case study.

3.2.2 The Case Study

This research project uses a case study research methodology. This approach can deal with a phenomenon and its context in a historical and real-time framework from multiple perspectives (Platt 1992). Case studies are particularly well placed to create a rich, detailed description of a complex, real-life intervention, such as the ILC. The case study method is used for the exploration of the ILC as perceived and understood by the key participants. It is used to illustrate and exemplify the particular construct, integration, within the ILC. The use of a case study that is strongly linked with evaluative research in the sense of providing formative feedback to initiatives or interventions (Lincoln & Guba, 1985) makes it suitable for the purposes of this research project.

Generalisability

Concerns are often raised about the generalisability of case studies. Such studies cannot be generalised to other populations or other cases, but they can be generalised back to theory, analogous to the way in which scientists generalise from experimental results to theory (Yin, 2003). For this reason it is important that the research is constructed on a comprehensive theoretical framework.

Reliability

When dealing with naturally occurring or interview generated verbal data, researchers cannot be sure that the participants would respond in the same way in similar situations, this is because situations are never entirely similar; contexts, needs, and even individuals change. My commitment is to reliability of the data in terms of attention to the selection criteria of data sources and careful data gathering.

Validity

Construct validity involves the relationship between the theoretical concepts and the analysis of the data. This can be broken down into the relevance of the researcher's 'categorisations' and the researcher's understanding of the 'procedural consequentiality of context' (Peräkylä 2004). Triangulation, a research strategy that involves using several methods of data collection or production to reveal multiple aspects of a single empirical phenomenon (Denzin 1978) is applied.

The case study predominantly addressed research questions 2 and 3 in the search for curricular possibilities and what would enable or constrain successful curriculum implementation of a curriculum.

The focus of the case study was a three-year National Diploma in Radiography at one higher education site in the Western Cape province of South Africa. The study involved an empirical study of two interacting activity systems: higher education (the academy) including academic and student groups, and the workplace with the practitioner group. The groups experienced a newly implemented curriculum in radiography, called the Integrated Learning Curriculum (ILC). This curriculum is an example of a local response to global technological advancement, the new professional identities and practices of radiographers, and the context that impact on the delivery of health care and health science education in South Africa. The ILC was evaluated for effectiveness in meeting the education needs of radiography, and in determining whether curriculum renewal was appropriate to the context of delivery. The case study maps the responses of key participants to curriculum renewal and tracks emergent paths as a means of contributing to the understanding of integration in professional education and to add to knowledge on integration in the curriculum.

The study of an ILC in radiography took the form of a 'large diffuse group' (Babbie & Mouton, 2001) type of case study. As an empirical inquiry, the case study is suited to practice-oriented fields such as education and health sciences (Yin, 2003). It was selected as the research method for an investigation of the contemporary event of an ILC in a real-world setting, where the researcher was an active participant and in a setting where the boundaries between the phenomenon, integration, and the context could not easily be identified (Yin, 2003). This research, located in the qualitative paradigm, used purposively selected accompanying data from the data pool generated through the evaluation of the ILC, suited to mixed quantitative and qualitative methods (Frye *et al.*, 2000) as well as observational and text data generated specifically for the case study.

Delimitations of the case study

The case study was delimited to a three-year National Diploma in Radiography at one site of a higher education institution in the Western Cape of South Africa.

One data collection source comprised individuals who were the major participants in the radiography curriculum, and the other were documentary data. A rigid determination of a data collection and analysis regime in advance was not possible in the light of the exploratory nature of the research, and these evolved during the research (Daly, 1996). However, the plan for data collection described under section 3.3.2 and the plan for data analysis described in Section 3.4.2 were followed closely.

Assumptions

This study emphasises the attitudes to, and perceptions of, the three key participant groups to the ILC. The researcher, as a member, of the academic group that regularly enters the world of the practitioners and students, is therefore investigating a familiar environment. In accordance with the respondent model, disclosure of expected responses from the three groups are presented as assumptions of the researcher as this might impact on the data collection and data analysis. This admitted opinion of the researcher about the three participant groups provides a basis from which to build the data analysis.

- *Students*

My general experience of the student body is of a group of enthusiastic young people who are on an exciting journey over which they want some control. With the charming arrogance of youth they know what is best without having experienced 'it', find good reason not to just accept things as they are and at times are right without a fully understanding why. This is coupled with the energy to challenge the academics and practitioners.

Curriculum renewal can go unnoticed by students because what is new or different to any previous curriculum is not necessarily recognised as the students travel through 'their curriculum', a unique educational experience isolated from the past. Their experience is independent of concern for those who came before or will come after them, that is, until they perceive they are being disadvantaged in some way. Then they are quick to compare themselves to what other students got, do, had or have that they do not and to demand some change.

Student opinion on the curriculum, both positive and negative, must be highly valued but with the knowledge that each student will have an individual response that will not necessarily remain consistent over time. An opinion is the intense view of an individual judging the curriculum for the effect it has on them at that time. It is their personal experience conveyed with passion in the moment. Their perspective, comments and requests will not lack insight but may well be delivered with limited consideration for their impact on others. They will recognize what they have appreciated and will challenge what they consider inappropriate. As the beneficiaries of the curriculum, their voice carries an important story that must be heard.

- *Academics*

Academics in radiography have close links with higher education and health care. In South Africa this means dealing with an enormous amount of instability and change as both worlds are adjusting to the demands of transformation and development. Radiography academics aspire to being current in the changing education and practice and the enormity of this task puts pressure even on the diligent. They take responsibility for the design of the curriculum and managing the learning environment and, in my experience, fluctuate between being idealistic and expecting perfection and being disheartened when things do not go in accordance with well thought out plans. Enthusiasm generally prevails and curriculum renewal is an exciting prospect, if somewhat daunting. Mixed feelings arise as the new replaces the familiar old and there is some grief over things left behind in the change. In this group I therefore expected motivation for curriculum renewal alongside resistance to change. I expected that it would be hard for some to acquire the skills and knowledge needed for true change and that this might lead to uncertainty and insecurity as the move was made from a place of expert to that of a learning facilitator.

So the perspective of academics on the curriculum they designed and implemented, with all its joys and hardships, was expected to provide insight through recognition of the gap between the goals of the intention and what they in fact managed to do. I anticipated that the academics would be willing participants who would contribute untiringly to curriculum renewal and, through this, to the data for this case study. I expected that there I would learn about the process, the enabling factors and the constraints through listening to them.

- *Practitioners*

The practitioners are struggling with an enormous amount of instability and change in the world of South African health care and adjusting to this change is essential if they are to cope and succeed as professionals. Practitioners are essential to the success of a radiography curriculum. We ask them to take on a dual role of expert practitioner and tutor. In my experience, they can be placed on a continuum from those who willingly and enthusiastically engage in educating the next generation of radiographers to those who clearly want only to practise without the added burden of teaching - and all those in between who do what needs to be done.

Practitioners have mixed feelings about curriculum renewal. As the new replaces the familiar old, there will be regret about aspects that are now lost or changed. Within the world of practice it is not easy to acquire the new skills and knowledge demanded of curriculum change. There can be insecurity when the education of students differs from how they were trained. So the perspective of practitioners on the curriculum they must help to design and implement is likely to be from a place of resistance to change, or hesitant acceptance of the need for renewal. A few practitioners may be eager and willing to be a part of the curriculum renewal process.

Selection criteria

This section explains the reasons and criteria for the selection of participants in the case study.

- *Students*

We can depend on students to comment on the curriculum they experience. The issue is how we offer this opportunity, whether we listen openly to really hear what they have to say and how we distil and use the information. The students that were heard through this case study were those qualifying immediately prior to curriculum renewal and those who experienced the ILC during the period of this study. Selection criteria did not exclude any student; however, event selection did not of necessity include all students and for each data collection event as participation was voluntary.

Data were gathered from a programme evaluation (Annexure H1) of students completing the 'old curriculum' (2000). Students on the 'new curriculum' for all three levels of the National Diploma in Radiography (2001 – 2003) were the primary student cohort. They were involved in a series of data collection events that included: observation; programme evaluation (Annexure H1); lecturer evaluation (Annexure H2); and focus group interviews (Annexure E). Data from observation and one data collection event (focus group interview) included students completing level one and two of the 'new curriculum' (2002 – 2003) and those who did level one only (2003).

- *Academics*

The academics participated as a consistent team throughout the period of the case study. No further selection criteria were added.

- *Practitioners*

Data from the practitioner group, who facilitated students' clinical practice in the radiography workplace, were gathered. Purposive sampling was used for the scheduled data collection events. Participation was voluntary.

The perspective of recent past students (as a sub-set of the practitioner group) was identified as having particular relevance to gaining an understanding of the curriculum from the position of the practitioner (Annexure D1; D2; D3; D4) relying on knowledge gained in higher education to succeed as a new practitioner in the work place (Engel-Hills *et al.*, 2005).

As the practitioner group did not involve the same individuals throughout the case study they should not have experienced any undue burden from data gathering. They, in fact participated willingly when asked, and always accommodated the research need while retaining the priority of practice.

Site selection

This research site is unique nationally and internationally. The only published study of an integrated curriculum located in a setting of this nature is some data from this case study (Engel-Hills, 2005a). At this site, the diversity in the student group and the health care environment to which they are exposed facilitated the opportunity for varied opinion and experience. Research in the environment of the researcher facilitated data collection through observation and participant observation over an extended period.

Event selection

The narrative verbal and text data were collected as slices of the experiences (Daly, 1996) of students, academics and practitioners within the system of radiography education over an extended period. Events were selected because of their anticipated importance in contributing to the research goals. Observation and participant observation, as the major data collection tools, allowed for data to be collected from all participant groups at naturally occurring events throughout the period of the study. In addition, events were scheduled for specific data collection from the student and practitioner group.

- *Students*

The aim was to collect text data from students at the end of the 'old curriculum' (November 2000) and then early each year (February 2001, January 2002, May 2003). The questionnaire data from the group of 73 local students were analysed separately and admitted to the case study data (April 2003). Interview data were gathered from students at the end of the 'old curriculum' (November 2000) and in the middle and at the end of the last year of data collection (June and November 2003).

I was aware of students on the newly implemented ILC being a 'test group'. I was also aware of the burden of evaluation and the possibility that, when students do not perceive a benefit to themselves, they lose interest in a data collection activity. An attempt was made to avoid participant fatigue, to use a variety of data collection methods and to use at least some of the data for immediate gain in some aspect of their programme.

- *Academics*

The academic team as a data source offered the opportunity for participant observation of continuous events during the full period of design and implementation of the ILC. The key events were the weekly meetings and planning meetings arranged specifically to discuss curriculum issues.

- *Practitioners*

Interview data were collected from practitioners near the beginning of implementation of the ILC (March 2001) and near the end of the study (June 2003).

3.2.3 The Curriculum Research Cycle

Before I explain the data collection and analysis methods, I find it necessary to describe the relationship between curriculum development and curriculum research in the case study. Curriculum development of the ILC started with the formulation of a vision and conceptualisation then moved on to planning and design before implementation of the revised curriculum. Realisation or completion was reached at the end of the three-year period of phased introduction of curriculum renewal. Research on the ILC also followed a cycle in order to address the dual situation of learning from an actual case of an integrated curriculum while reaching more clarity on the definition of the reference, the ILC. Through a case study of one example of curriculum response there was learning about the integrated curriculum and how it might be defined and described. There was also learning directly related to the ILC. This was learning about options for changes to the ILC to achieve the initial curriculum goal of enhancing the integration of professional knowledge from the academy and the workplace, as well as learning about how the overall curriculum goal/s might or should be adapted. The curriculum and research phases followed a cycle described in Table 3.1. These phases were integrated into a connected cycle, the Curriculum Research Cycle, adapted from personal communication[1] and the 8 stages of programme implementation and evaluation of Sycamnias (1999).

A curriculum research cycle is supported by the belief that we, as educational researchers, can improve the lives of those we study (Lather, 1986). In this research cycle, the implementation and part of the realization phase are the field work, the data analysis in the realization phase are the head work and the outputs

[1] Acknowledgement to Professor Arie Rip for in-put during discussions in November 2004.

in the form of publications and this thesis are the text work (McWilliam, Lather & Morgan, 1997).

Table 3.1: Curriculum Research Cycle for the Integrated Learning Curriculum

Curriculum Development Phase	Research Phase
Formulation - Problem/Issue *(Get a sense of the environment and Vision)* Explore how to better meet demands of changing context in South Africa for radiography education and training.	
Conceptualisation - Action/Strategy *(Strategic Plan)* Alternatives for curriculum reform sought and expanded on. Implications considered and evaluated until an option was selected.	
Planning and Design *(Operational Plan)* Subject integration and the integration of generic competencies to improve workplace knowledge/competencies. ILC selected.	
Implementation ILC implemented in a 3-year phased introduction cycle.	**Formulation – Problem/Questions** *(Goal)* Considering what is/are appropriate goal/s for an ILC and what the ILC, is the research questions were: What is the nature of radiographic knowledge? What curricular options would facilitate radiographic knowledge? What would enable or constrain successful curriculum implementation? Is the ILC an appropriate curriculum for Radiography?
	Conceptualisation – Literature Research and theory to support and conceptualise this study. Alternatives evaluated and study design determined.
	Design and Planning *(Research Strategy)* Case study with *Unit of Analysis*, the *ILC*. *Data Collection Sources: Individuals* - major participants in the radiography curriculum; students, practitioners and academics and *Accompanying data* - evidence in the form of documentation, participant observation and reflection.
	Implementation *(Data Gathering)* Research implemented according to design with flexibility for unexpected in dynamic curriculum reform research.
Realization 3-year implementation cycle completed and evaluated.	**Realization** *(Data Generation/Analysis)* Data collection, analysis and interpretation completed.
Evaluation of appropriateness *Is the Goal still appropriate? Was the Goal achieved? Are there other or modified goals?* To answer: **What can and should an ILC be?**	**Outputs** *(Research output)* The *Study Findings* presented as a thesis. Relevant literature integrated into the presentation of the findings of the study to enhance learning.
Curriculum phase repeated New curriculum cycle to invoke learning from research cycle into curriculum development cycle.	

3.3 Data Collection

As explained in the research design, data were obtained from two main sources: 1) a national survey of academic, practitioner, and student radiographers; and 2) the case study of the ILC.

3.3.1 National Survey

A survey was conducted using the questionnaire (Annexure B) to elicit the responses of three participant groups (practitioners, academics and students) in order to gain their perspective on radiography education in South Africa. In particular, opinion and attitude regarding the recent changes in radiography education were sought. The questionnaire was standardized and all participants answered the same questions. This permitted the opinion of the three groups to be compared where this added to understanding and interpretation.

A pilot of the questionnaire was conducted with eight people representative of the participant groups (6 students, 1 academic and 1 practitioner). As an outcome of the pilot was to identify language issues, four of the group were persons who have English as a second or third language. At the debriefing session, the pilot group commented on the experience of answering the questionnaire and provided feedback on each question with regard to ambiguity, misunderstanding, misinterpretation and other aspects, which they thought relevant. The questionnaire was adjusted to incorporate the comments of the pilot participants.

3.3.2 The case study

The research plan included opportunity for gathering information that was integral to the curriculum renewal process. The accompanying data were reconstructed in order to meet the goals of the case study. In addition, data were generated through participant reflection on their experience of the changing environment. The case study therefore involved observation of the implemented curriculum at all levels of the National Diploma as well as the tracking of the review and adjustments to the curriculum over time to produce observational, graphic, oral and written textual data. Narrative data were used as a way of eliciting the meaning that the participants ascribed to their experience of the radiography curriculum. The intention of the research design was to resist reductionist readings and provide a more complete account of the complexity of the environment (Engel-Hills *et al.*, 2005).

The empirical data of the case study were gathered from the ILC in radiography in practice, rather than on paper, and was an empirical field inquiry with an interpretive slant. The effectiveness of a curriculum can be said to be determined by the students and academics that are part of the curriculum process and by interested external parties (University of Vermont, College of Medicine, 2003) and therefore the gathering of participant response to the ILC was central to this research.

The collection of text data were from multiple sources within the activity system through a multi-method research approach, including questionnaires, reflective and free writing, focus group interviews, observation, image artefact and selected documental evidence. These all contributed to data triangulation that enhanced the validity, reliability and quality of the data. The data collection methods, including participant observation, are considered appropriate due to the data being an exploration of the everyday responses of participants (Silverman, 2000).

Initial questionnaire

A questionnaire (Annexure A1) was distributed to students on their first day in February 2001 when the ILC was implemented. The report of this survey (Annexure A2) and a publication (Engel-Hills, 2005a) are an integrated component of the case study.

Observation

Observation and, in particular, participant observation as a means of gathering data in the natural setting as the events take place were data collection methods in this case study where the researcher is an academic on the radiography programme. The research took into account the disadvantages of observation being time consuming, needing extensive coverage rather than narrow selectivity and the very fact of observation influencing the process (Yin, 2003). Oral and written data were gathered on a continuous basis at events such as meetings and discussions that the researcher attended. This allowed extensive coverage over an extended period and reduced the weaknesses of a single long event (Yin, 2003), but with rational time commitment. The influence of observation on the process is acknowledged and some assumptions have been expressed to place the findings within a transparent framework.

Reflective writing

Participants produced reflective writing, prompted by brief instructions. Reflective writing was used as a narrative data gathering tool from students and from newly qualified practitioners (Annexure D1). A question or topic was used as a focus to stimulate and guide the respondents to reflect on their life as a student from the position of learner or recent employment in radiography. The responses showed that, while the participants started by being confined to the question or topic, they wrote beyond the limitations of the stimulus as they relaxed. This method of data collection allowed for a variety of thoughts related to the issue of integrated curriculum.

Focus group interviews

Focus groups give participants the opportunity to listen to one another and to discuss issues that arose. In this way they are able to present a personal view while contributing to the group understanding (Cys, 2000), or to create meaning as a group rather than as individuals (Babbie and Mouton, 2001). Semi-structured focus group interviews were seen as appropriate for interacting with students (Annexure E), and practitioners (Annexure F), regarding the radiography curriculum and for collecting data that explored the participants' experience and understanding of the ILC. Focus groups were purposive samples large enough to be credible for the purpose of the research but small enough to permit adequate depth and detail (Patton, 1987). The one large focus group of nineteen students was representative of all levels and categories but other focus groups ranged between five and nine participants. The questions were exploratory and open-ended in the main, though direct questions were asked when specific information was wanted (Annexures E and F). These questions were used to initiate discussion and the free flow of ideas and comments on radiography education in order that important information would be expressed, but without losing the ILC as the focus. The researcher as facilitator did not participate in the discussion unless asked a specific question that required a response or to maintain the direction and aim of the focus group. Focus group interviews lasted 30-45 minutes and were either recorded and transcribed, or notes were taken to record the responses.

Artefact data

Artefacts include a wide range of possible sources of physical evidence that can be observed or collected during a case study (Yin, 2003). This case study allowed for possible artefacts, although those actually collected were unique and unexpected (Annexure D4). In considering the entry of this material as data, Morse, Swanson & Kuzel's (2001) consideration of qualitative evidence as linked to what can be considered as evidence in terms of 'evidence based medicine' was helpful, as an artefact can be considered to be an organized body of information that can support or challenge a proposition or matter at hand. Other artefact data were generated by the academics when they presented a seminar to radiography students and practitioners at a major clinical training site. Four power-point presentations were admitted as artefact data.

Unsolicited data

The researcher's familiarity with the context and persons in the activity system gave rise to unsolicited evidence from students, academics and practitioners. When viewed as relevant to the ILC unsolicited data were gathered in the form of oral and written text. For example, there were unexpected comments in noncurriculum meetings and letters or oral comments from past students. Verbal data were recorded as a diary entry which could be referred to at a later date. Unsolicited data were found to be useful in confirming opinion, triangulation, generating questions for clarification and identifying misunderstandings.

Accompanying data

Selected existing documentary data from a four-year period covering a broad range of activities and interactions on the ILC were admitted to the data set. Such existing information was a useful longitudinal data source that could be collected unobtrusively, was inexpensive to collect, is historically and methodologically unique and could be rechecked (Kellehear, 1996). These documents were used to triangulate evidence from other sources (Yin, 2003) and strengthen the validity of the case study. Accompanying data included: Institutional Policy, Strategy and Guideline Documents, SAQA outcomes of 1999 for radiography, a report on the initial questionnaire (Annexure A2), Study/Learner Guides, Clinical Work Record books, student portfolios, assessments and assessment schedules, clinical placement rosters, academy schedules, minutes, examiner/moderator reports, records of meetings and quarterly reports by students on their clinical experience (Annexure G). All documents were reviewed and the evidence distilled was recorded on a data sheet (Annexure C).

Data summary

Data were gathered from the students, academics and practitioners involved in the ILC through various methods throughout a four-year period from July 2000, when the programme was conceptualised, to June 2004, when the curriculum evaluation for this revised curriculum was completed. Data collected specifically for the case study and accompanying data generated through the normal curriculum process were also gathered and analysed. Tables 3.2 and 3.3 tabulate the primary evidence gathered in real time. All data collection activities were allocated a code and all participants a number. Direct quotes attributed to an individual are identified by the activity code, for example RWS035 is reflective writing from student number

5 in 2003 (Table 3.3). The research questions: 1) what is the nature of radiographic knowledge; 2) what curricular options would facilitate radiographic knowledge; 3) what would enable or constrain successful curriculum implementation; and 4) is the ILC an appropriate curriculum for Radiography; guided the selection of data sources. The data sources were in the main used to answer particular research questions. These are indicated in brackets under each activity in Table 3.3. It is however noted that data sources frequently contributed to information beyond what was planned for.

Table 3.2: Case study data collected prior to implementation of the ILC

Group	Research Activity (main question/s addressed)	Date	Data	Reference (direct quotes)
Students 'old curriculum'	Programme evaluation (Question 2) Personal reflections (Question 2) Focus group interview (Question 2)	Nov 2000	Text data	SOC/(1-15)
Academics	Participant Observation (Question 1, 2, 3, 4)	July – Dec 2000	Field notes Meeting records	AG/(1-9)
Practitioners	Participant Observation (Question 1, 2)	Oct – Dec 2000	Field notes Meeting records	

Table 3.3: Case study data collected during implementation and review

Group	Research Activity (main question/s addressed)	Date	Data	Reference (direct quotes)
Students				
National group	Questionnaire (Question 1)	Apr 2003	Numerical and Text Data	QS /(1-91)
CPUT group	Questionnaire (Question 1)	Apr 2003	Numerical and Text Data	QCS/(1-73)
Level one	Initial Questionnaire (Question 2) Participant Observation (Question 1, 2, 3, 4)	Feb 2001 2001 2002 2003	Report Field notes	IQS/(1-26) SG101/(1-30)
Level two	Participant Observation (Question 1, 2, 3, 4) Reflective writing (Question 1, 2, 3)	2002 2003 Jan 2002	Field notes Text data	 RWS02/(1-24)

Level three	Reflective writing (Question 1, 2, 3) Focus group interview (Question 2, 3)	May 2003 June 2003	Text data Interview transcript	RWS03/(1-12) FGS1/(1-5) FGS2/(1-9)
Mixed group	Focus group interview (Question 2, 3)	Nov 2003	Interview transcript	FGS3/(1-19)
	Unsolicited		Diary entries	UP/(1-8)
Academics				
National group	Questionnaire (Question 1)	April 2003	Numerical and Text Data	QA/(1-12)
Local group	Participant Observation (Question 1, 2, 3, 4) Artefact (Question 1, 2) Unsolicited	2001, 2002, 2003 June 2003	Field notes Power point presentations Diary entries	AG/(1-9) AG/(3,6,7,9) AG/(1-9)
Practitioners				
National group	Questionnaire (Question 1)	April 2003	Numerical and Text Data	QP/(1-29)
Local group	Participant Observation (Question 1, 2, 3, 4)	2001 2002 2003	Field notes	
Local group	Reflective writing (Question 2, 3,)	March 2004	Text data	RWP/(1,2)
Local group	Focus group interview (Question 2, 3)	March 2001 June 2003	Flip chart notes Transcript Transcript	FGP1/(1-9) FGP2/(1-6) FGP3/(1-8)
Local group	Artefact (Question 1, 2, 3)	March 2004	Model	AG/1
	Unsolicited		Diary entries	

3.4 Data Analysis

The explicit aim of the data analysis was to address research question 4 and through this to identify if the ILC is an appropriate curriculum for Radiography. This study included text from several genres arising from a radiography curriculum. There was written discourse, typical of the texts that represent the external influences on curriculum, such as SAQA registered outcomes, institutional policy, Learner Guides; and spoken discourse, transcribed to written text, that was generated from participants of the curriculum renewal process who were given the opportunity to express their experience. The interpretive analysis permitted the exploration of the multiple texts for alignment or contention. This was mainly from the meso-level of the working group of academics and the micro level of individual participants and focussed on the content and context to illuminate emerging themes and discourses (Kress, 1985).

The data sources were wide and included varied groups over an extended period. In addition the number of respondents for each data collection item of a single data source could vary. This means that the size of the group or number of respondents/participants is not consistent. The number for each data source and for each item, where relevant, is given to guide the reader.

3.4.1 The national survey

The national survey included numeric and text data on the opinions of key participants in radiography programmes in South Africa. The responses to the open question format generated written text by participants who had the opportunity to express their perspective on radiography education.

Units of analysis: national survey

The unit of analysis of the national survey was radiographic knowledge, in the forms of the various participants' understanding and experiences, including: the content/cognitive knowledge of radiography; process knowledge of how to do radiography; knowledge about the profession of radiography; and the skills and abilities needed for actually doing radiography (Jarvis, 1999a).

The questionnaire generated essentially verbal responses to questions that could be analysed numerically as the respondents were asked their opinion of aspects of radiography education and responded according to a semantic differential. For the closed questions, the response categories were as exhaustive as possible but there was always the opportunity for additional items to be added. The option of 'cannot say' was included as appropriate to encourage respondents not to make up an answer or leave a blank. Questionnaires were well answered and all returned documents were used in the numerical analysis. The number of respondents varied due to the selective components of some questions and missing data such that all results accurately reflect the number of respondents and valid percentages using the actual frequency for each item. SPSS software was used to perform a numerical analysis and statistical calculations. The frequency of an opinion is what is presented here. Respondents needed to provide a short narrative answer to open-ended questions. This verbal data were analysed using semantic analysis and presented as nominal measurement according to codes that were partially pre-identified but that allowed for additional themes to emerge (Freeman, Miller & Ross, 2000).

All participants were allocated a number and in Table 3.3, data attributed to the individual are identified by the code Q (questionnaire) followed by S (student), SC (CPUT student), P (practitioner) or A (academic) and then the number, for example, QS71 is student number 71 in the national survey.

3.4.2 Analysis of case study data

This study included text from several genres arising from a radiography curriculum. There was written discourse typical of the texts that represent the external influence on curriculum, such as SAQA registered outcomes, institutional policy, Learner Guides; and spoken discourse, transformed to written text, that was generated from participants of the curriculum renewal process who were given the opportunity to express their experience. The interpretive analysis permitted the exploration of the multiple texts mainly from the meso-level of the working group of academics and the micro level of individual participants for alignment or contention and focussed on the content and context to illuminate emerging themes and discourses (Kress, 1985). The findings of the analysis address research question 4, on the ILC as an appropriate curriculum for radiography.

Unit of analysis: case study

In summary, the unit of analysis of the case study was the ILC, a shared object in two dominant interacting activity systems, the academy and the workplace.

Data analysis and interpretation

The analysis of integrated curriculum through the in-depth investigation of one ILC led to a description of the ILC curriculum, an exploration of why and how this curriculum was implemented and knowledge development on integrated curricula in the health sciences. The analysis and interpretation included linking the data from the national survey to the findings of a case study. Connections were made and understanding gained through a process of theme identification and a search for alignment or contradiction between the identified themes and the original propositions generated from the investigation of the ILC context. Analysis of data included examining, categorizing, coding into identified or emerging themes (Annexure J) and testing against theory in order to address the research questions (Yin, 2003). The categories and themes already identified were used as initiator themes but were modified as the case study progressed in order to present more developed coding for an integrated curriculum.

The work of Rose (2001) was used to inform the interpretation of the visual, artefact evidence. This facilitated information from different data sources being cross-referenced in order to reach agreement for analysis of an integrated curriculum, as a response to the needs of the modern workplace. Throughout the data analysis consideration was given to using the evidence fairly in order to generate analytic conclusions after considering alternative interpretations. The analysis also took cognisance of the fact that the data could not lead to a truth but to understanding of an integrated curriculum and explanation building (Yin, 2003).

All data collection activities were allocated a code and all participants a number. In Table 3.3, data attributed to an individual are identified by the activity code, for example FG (focus group) followed by S (student), P (practitioner) or A (academic) and then the number, for example, RWS035, is reflective writing from student number 5 in 2003.

The potential bias of a case study approach, in particular with the researcher as a participant observer, is an ethical issue that was fore grounded. Daly (1996) proposes that the qualities and characteristics of the researcher are essential for ethical research and that a researcher should develop qualities of 'prudence, honesty, humility and care'. There was therefore commitment to moral and ethical research through an intention of honesty and transparency at all stages: in the selection of interviewees, procedures for data collection, analysis and the reporting of the findings. There was awareness of the possibility of bias and the researcher attempted not to compromise research ethics due to pressure from others. This was done with awareness that there could be differing opinions on ethics and morality, thus sensitivity to the views of others was needed throughout data gathering, data analysis and reporting activities.

3.5.2 Ethics and the participants

The ethics of intrusion was a consideration and care was taken to minimize the invasion of privacy and inconvenience to the participants of this study. The participants were aware of the research and consented to the data collection activities after an oral briefing that was at times followed with a written explanation. Students were informed about the research via an initial process of dialogue and informed consent and because of the protracted data collection process, each research activity was reaffirmed as voluntary.

The briefing information covered the research purpose, reasons for the data collection method, the right of voluntary participation and the possible benefit of the research to the researcher, the participants and others. The principle of voluntary participation was strictly adhered to and the participants were aware that they could withdraw from the data collection process at any stage, even part way through an activity. Wherever possible, there was anonymity but, where the researcher knew the participant, identity data were treated as confidential. The autonomy of the participants was not impeded by coercion or inducement and the students, known to be the most vulnerable, were protected and respected at all times with regard to autonomy, rights and dignity.

In the semi-structured focus group interviews, each participant was always given an opportunity to answer each question, although they were not under any obligation to speak if they chose not to. The order of speaking was not rigid, so that there was space for discussion among the participants.
Data collection did not result in any student gaining what could be construed as a 'better' quality of learning experience because of their participation and there was also no risk of harm to participants or non-participants. It is, however, acknowledged that, while not harmful, the effect of the changes through this research may not all be positive for all role players. This is not the final word. The need for continuous curriculum research is essential in order that the analysis of any present curriculum can inform future curriculum development. The inconvenience to the students, academics, patients and practitioners was minimized and at no time was the safety of those involved jeopardized in any way.

3.5.3 Ethical reporting of the study and findings

It is the right and responsibility of the researcher to endeavour to bring the research into the public domain (Jesani & Barai, 2000). The findings of this study will be made public through this thesis and through publications and presentations. To this end, there has been a joint publication (Engel-Hills *et al.*, 2005) and conference presentations of elements of this research. This is in line with a commitment to the research being accessible to all the participants and to any others who are interested and will meet the expectation of the sponsor who made a financial contribution to the research.

3.6 Reflections on research design and method

In line with Yin's (2003) motivation that a researcher's ideas about a case study have deep roots in their research experience, I selected to research an ILC that I am directly involved with. This was conducted within a framework of multi-method research that benefited from my initial experience of quantitative medical research and from my later involvement in social science research. My reflections on the research design and data collection methods and my consideration of the strengths and weaknesses of these are a means of permitting my journey as the researcher to contribute to this research project.

Posner (1992), suggests that, to study curriculum in general, there is the need for an in-depth examination of a single curriculum'; and Rip (2003b) states that there is methodological importance in selecting sites that, while not statistically representative, will 'yield significant data because they open a window on the world'. Hence, the design of applied research of the ILC was selected as 'knowledge-oriented evaluation' (Babbie & Mouton, 2001) for gaining understanding of the integrated curriculum.

This research was conducted in the context of application, with a team involved in curriculum renewal. The research was interdisciplinary with heterogeneous skills and experience and there was a problem-solving intent for using reconfigured knowledge (Gibbons, 1998). Research in the real world, where the researcher is a participant and the research is happening largely 'with' the participants and less frequently 'on' the participants, is in line with the concept of 'participant action research' (Carr and Kemmis, 1986; Kemmis & Mc Taggart, 1988). The research methods were therefore less obtrusive than as happens in action research (Kellehear, 1996). However, the 'action research cycle' is not the design of this project and, while the research did contribute to the curriculum of the case, the research outcomes were not necessarily of direct and immediate benefit to the community involved in the research. Describing this project as 'critical education research' through the study of a single case might therefore be appropriate. This is stated with awareness of Lather's (1991) finding that the discourse of post modernism is useful, but one must be wary of its tendency to present emergent, multiple-sited, contradictory movements as stable and immoveable and the caution that positivist research is inadequate for knowledge production on curriculum. As a reflective researcher, I have taken as the central objective of this project the formulation of a guiding framework that will aid in the design and evaluation of an integrated curriculum. This study is therefore dynamic research done in a specific context. The participants, a multidisciplinary group, were broadly identified but there was flexibility to allow participation to evolve further during the research process in order to ensure that the data generated were as rich as possible. The research can therefore be described as post positivist, critical research, which is directed toward positive curriculum change in health science programmes.

There was opportunity to position and reposition myself as a researcher along a continuum of research strategies within an essentially qualitative design. The choice of method was determined by the research question from the range of research methods available with regard for the constraints in the context. Unscheduled transaction spaces, beyond the confines of the anticipated design, were included if appropriate to the contribution they could make. There was therefore the use of research methods, such as survey by questionnaire, to validate findings, alongside richer methods, such as narrative research and unexpected visual evidence. The multi-method approach compensated for the inherent weaknesses of each method and culminated in an approach that could possibly be called 'illuminative evaluation', an approach that is used in the field of education to interpret practices and participants' experiences.

4. A National survey on Radiography Education in South Africa

> The hard epistemological core of science which is repeatedly invoked as the sole guarantee for its continued delivery of the goods that society so highly values (but also feels free to contest), arguably has turned out to be crowded with a variety of norms, and practices which cannot readily be reduced to a single generic methodology, or, more, broadly, to privileged cultures of scientific inquiry. Rather, there are many different, local and heterogeneous clusters of shifting scientific beliefs and practices, which value and combine different elements of objectivity, of proof and demonstration. They are robust and reliable in different degrees and yet they succeed in bringing creatively together heterogeneous conditions under which these local clusters can operate (Nowotny, 2000: 15-16)

4.1 Introduction

Chapter four presents and interprets data at the national level. First, I present a profile of the South African radiographer from several national sources of data; second, I present and analyse the opinions of student, academic and practitioner radiographers canvassed in a national survey, and finally, I draw out the implications of the findings and their interpretation, for curriculum development in Radiography.

4.1.1 The South African Radiographer: A profile

The total number of registered radiographers in the country has grown steadily from 4,295 in 2002 to 5,221 in 2005 (Health Professions Council of South Africa, 2004/5). However, the number of radiographers working in the public health sector has dropped by about 3.5%; from 2,116 in 2000 to 2,048 in 2005 (Health Systems Trust, 2005). In this period there was restructuring of health care so the reduction was not consistent in the nine provinces. There was in fact a decrease of radiographers in the three well-resourced provinces and an increase in the other six provinces. This meant a 26% reduction in the Western Cape; the site of this study, compared to a doubling of radiographers in the two most poorly resourced provinces of the country. The equity agenda in a transforming South Africa should impact on radiography. The changing demographics of a 13% reduction in white and 11.5% in coloured radiographers might therefore be expected though the small increase of 5% in black radiographers and the large increase of 44% in Asian radiographers (Health Systems Trust, 2005), is less expected. Gender statistics are not currently available but as radiography in South Africa is historically a female dominated profession the transition is opposite to the general national gender equity need to promote women and men are more and more encouraged to enter radiography.

Responsibility for radiography was transferred to the Peninsula Technikon [now the Cape Peninsula University of Technology (CPUT)] in 1992. This is largely responsible for the marked increase in white females at the institution between 1987 and 1997 (Chand & Misra, 1999). The racial and gender equity priority for the country has resulted in demographic change in the student body in higher education in South Africa. There was an increase in student numbers from 480,000 in 1993 to nearly 700,000 in 2002. This contributed to righting the deficit in the apartheid system as the proportion of black students grew from 46% to 66% in this period while the proportion of white students fell from 47% to 27% (International Education Association of South Africa, 2004). The change in radiographer demographics is a reflection of the changing demographics of the student body with an increasing number of black students that is marked at some institutions and hardly evident at other sites. These changes are not reflected locally in radiography where the transition at CPUT is below what is expected nationally. Over the period 1993 - 2002 there was not a significant increase in radiographers qualifying and the number remains at about 200 per year from the eight higher education institutions that have a radiography programme.

4.1.2 The National Survey

The aim of the national survey was to canvass the opinion of key participants on radiography education in general. A postal survey (Appendix C: Questionnaire on Radiography Education and Training in South Africa) was conducted in 2003. The overall return rate of 44% represents academics (12), experienced and novice practitioners (29) and students (91). Respondents were from five of the eight the small increase of 5% in black radiographers and the large increase of 44% in Asian radiographers (Health Systems Trust, 2005), is less expected. Gender statistics are not currently available but as radiography in South Africa is historically a female dominated profession the transition is opposite to the general national gender equity need to promote women and men are more and more encouraged to enter radiography.

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4.2 What South African radiographers say about teaching.

The responses that consider what is said about teaching contribute to answering the research questions; what curricular options would facilitate radiographic knowledge and if the ILC is an appropriate curriculum for Radiography?

Radiography education makes use of many different teaching methods: these include formal lectures, classroom discussions, group work, student presentations, demonstrations, tutorials and guided practice in clinical settings. Respondents were asked to rate these approaches according to whether they found them useful or not useful.

4.2.1 Which teaching methods are useful/not useful?

Academics value the full spectrum of teaching and learning activities but emphasise a teaching process that introduces basic principles, allows space for learning from practice and self-study, and accomplishes assessment through assignments instead of written tests (Engel, 1994). Practitioners tend to value a more 'straightforward' (Flanders, 1970) approach. They recommend teaching approaches that are directed towards the practice of radiography, and which prepare the student for the workplace. Their emphasis is on practical rather than cognitive knowledge, which is the traditional 'head/hands' divide in thinking about vocational education. This has been challenged by the insights of 'new vocationalism' (Symes & McIntyre, 2002), which critiques traditional ideas and highlights instead the growing complexity of professional learning contexts

(Gibbons *et al.,* 1994), technologies (Bennett, Dunne & Carre, 2000), and practices (Boshuizen, Bromme & Gruber, 2004). Practitioner response indicates a need for curricula to draw together the worlds of academia and practice, while understanding and valuing their differences (Dias *et al.*, 1999).

While the student cohort concedes that most teaching forms have value, they like it best when the lecture is exciting. There are some teaching approaches which some students do not consider to be productive: 29% of the cohort does not consider group work to be useful; and 25% feel that student presentations are not helpful. Research has shown that group work can be difficult for students when groups are not well managed, or when there is perceived unfairness in workload sharing within the group (Johnson & Johnson, 1975; Schmuck & Schmuck, 1988). What has also been shown is that students benefit from well-managed, focused peer interaction, and peer assistance (Bruner, 1986). Students' dislike of presentations is understandable, as public presentation can be an extreme stressor (Gardner, 1983; Keirsy & Bates, 1984). However, to develop the field of radiography there is a need for radiographers to make presentations within their institutions and at academic conferences. Placing this demand on students is what Ausubel (1978) calls 'an advance organizer', that is, a requirement on students to prepare for a potential future event or desired state of the profession.

Despite some reservations and differences the respondents are largely in agreement that teaching methods currently employed are useful (Table 4.1).

Table 4.1: Radiographers' opinions on teaching methods currently in use

Academics (N:12) agree that current teaching methods are useful	100%
Practitioners (N: 29) agree that current teaching methods are useful	91.3%
Students (N: 91) agree that current teaching methods are useful	95.5%

4.2.2 Has Radiography teaching changed?

A perception amongst the respondents, with strong agreement between groups, is that academics have changed their teaching methods in recent years (Table 4.2).

Table 4.2: Radiography teaching has changed

Academics (N: 12) agree that teaching methods have changed	100%
Practitioners (N: 29) agree that teaching methods have changed	96%
Students (N: 91) agree that teaching methods have changed	81%

4.2.3 How should teaching change?

The qualitative data includes a wide variety of suggested changes to the radiography programme by the student, practitioner, and academic cohorts.

Practitioners position themselves as the experts in radiography practice. As such they want to be included in programme design in more meaningful ways to impact on clinical training that is not unexpectedly the focus of changes they suggested to the radiography programme. They are of the opinion that a regular clinical tutor is beneficial to professional learning in radiography. This is supported by the literature on the need for mentors to enable students' transition from the academic to the clinical world (Prince & Boshuizen 2004). Practitioners consider that a productive curriculum would entail the achievement of - 'more practical outcomes' (QP/3)[2] and 'less detail of subjects (theory) that is hardly used' (QP/4). Their in-put places emphasis on applied knowledge, so that they call for lectures on useful content such as more 'specialized lectures in appropriate fields' (QP/9) and 'more pathology lectures for pattern recognition' (QP/14). The practitioners' focus on the world of practice was not limited to thinking only about radiography directly. One practitioner wants 'more self-study assignments instead of tests' (QP/23) and another wants 'students to be taught how to be effective in acquiring knowledge in the medical world' (QP/15).

[2] A code and number identifies respondents when a direct quote is used. QP/x is a practitioner quote, QS/x a student quote and QA/x an academic quote from responses in the national survey.

By far the majority of practitioners and students indicated a low opinion of the benefit of academic learning to being a radiographer and criticise radiography programmes because in their opinion these err on the side of too much academic content. So too the academics understand the benefit of learning from work, and that situated learning, as a function of the activity, context and culture from being involved in a 'community of practice', has enormous value (Lave & Wenger, 1991; Wenger, 1998). They also however acknowledge the need for learning in the academy. Shifting the definition of legitimate academic knowledge and the understanding of work and workplace as a site for academic curriculum where work and learning are coincident rather than a site for work experience (Boud & Solomon, 2000) will benefit radiography if we take up the challenge. Therefore, the argument should not be academic knowledge versus practical skills, but rather how best to integrate the two important aspects and what site is best for what learning outcome. A work integrated learning curriculum does not guarantee quality or useful learning unless the content of the academic disciplines are blended with the competencies for clinical practice to enhance the students' acquisition of academic and workplace knowledge such that both are valued and neither ignored. An environment that enables learning for immediate professional practice, and that provides a firm disciplinary foundation with generic competencies to enable future learning, will enable the radiographer to move forward to build a radiography knowledge base and be a true professional.

4.3 What South African radiographers say about learning

The responses that consider what is said about teaching contribute to answering the research questions: what curricular options would facilitate radiographic knowledge and is the ILC an appropriate curriculum for Radiography?

In this section the opinions of the respondents are presented in five broad categories: 1) students' need for guidance in learning, 2) the need for a student-friendly learning environment, 3) the need for enriching learning experiences, 4) the importance of life long learning in radiography, and 5) the difficulties students experience with change in the learning environment.

4.3.1 Learning radiography content: provide or guide?

Students indicated that radiography has 'too much theory' (QS/89). Opinion was divided on whether the lecturers should 'guide' them in the acquisition of this information, or the more frequent view to 'provide' it in the form of pre-digested handouts and other texts. Academics are aware that content over-load does not promote deep learning but leads to surface learning (Entwhistle & Tait, 1990) though they are divided on how much to provide and in what format. Table 4.3 gives an indication of the varied opinion on guide or provide. The mismatch between the academic and the student opinions is inevitable as practices change from traditional transmission pedagogies towards constructivist understandings of teaching and learning (Edgerton, 2001; Chickering & Gamson, 1987). Wedell's (2003) research on the curriculum change process and responses to teaching and learning innovation in higher education, points out the difficulties that face teachers and learners in periods of change. It is suggested that a number of conflicting requirements need to be balanced, such as: maintaining meaningful and effective traditions, while introducing the best of current thinking; providing enough support for students, while fostering their independence; and valuing the past, while preparing for the future. Table 4.3 seems to indicate that learning itself is a 'learned behaviour' (Steffe & Gale, 1995) and that students need to learn how to learn, particularly if they are learning in ways that might be different from their learning experiences in school (Illich, 1970; Bruner, 1986).

Table 4.3 Are students too dependent on lecturers?

Students (N: 90) want lecturers to provide guidance only	45%
Academics (N: 12) believe they are there for guidance only	50%
Students (N: 90) want lecturers to provide them with content information	75%
Academics (N: 12) believe they should provide the content information	25%
Practitioners (N: 29) believe students depend on lecturers for content	80%

Many respondents acknowledged the importance of independent learning (Harden, 2001a), and such comments are typical of their responses: 'must develop critical thinking and problem-solving skills' (QA/3), 'create a sense of independent studying...do research and make you use the resources available' (QS/12), and 'developing a searching/investigating mind' (QP/15). There were also qualities of self-directed and independent learning that are related to practice such as, 'train radiographers who can think independently, work independently and solve problems' (QA/2), 'put forth self-sufficient radiographers who can make practical decisions and who are capable of lateral thinking' (QS/23), 'integrate a sense of independence and responsibility...to work in the team' (QP/1), and 'have good skill at self guided study, which can further help me to develop or enrich my profession after the qualification' (QS/28). This opinion, which indicates that there is a connection between being developed as an independent learner, in order to be an independent practitioner who has the 'confidence to work alone' (QP/28) is confirmed by research findings on independence in learning (Bennet, Dunne & Carre, 2000).

Though the strength of the positive opinion varies, there is a counter trend emerging from the data that student radiographers are overly dependent on lecturers, particularly for academic knowledge. The majority of students want the lectures to provide information, the majority of practitioners think students are dependent on lecturers for information and while few academics think they should be depended on for information (Table 4.3) many of them were of the opinion that the students do depend on them. Hence the matter of whether lecturers are facilitators of learning, or there to teach information, is not a consensus opinion and remains a challenge for future curricula.

4.3.2 Radiography education should be student centred

Student-centred learning is dependent on a range of factors, in particular lecturers' ability to accommodate a range of learning styles within the group (Gardner, 1970; Keirsey & Bates, 1984) and educational innovations aimed at fostering student-centred, active learning (Moust, Van Berkel & Schmidt, 2004). Although the opinion on the qualities and characteristics of lecturers as a group is merely representative of a general perspective about the academics in radiography, there is some value to discussing the opinion as reflected. In the survey, students were less convinced that academics empower others and academics generally had a stronger opinion about their positive characteristics. Still the general opinion of the three groups, shown in Table 4.4, did indicate that on the whole academics act in ways that are consistent with a student centred approach. In this approach there is a shift away from the teacher being in control to students taking responsibility for what they do and actively thinking about why they are doing it (Cannon, 2000; Biggs, 1989; Biggs, 1999; Shuell, 1986). The academic is the key to a student-centred approach and the survey indicates a positive, but at times inconsistent, opinion of the lecturer. Hence there is need for further development of aspects such as creating an environment of negotiated decision-making where there is wider inclusion of involved parties such that a spectrum of opinions is heard and responded to.

An important principle of student-centred learning and OBE is that some students will take longer to learn particular skills or areas of content (Keirsey & Bates, 1984). The opinion of the students and practitioners appears to imply that individual students require a time frame to suit them as individual learners and that this is accommodated for practice learning (Table 4.4). By contrast the academics' appear to see a structured schedule that allows little individual flexibility. This opinion is likely to be a reflection of the difference between formal opportunities designed by the academics and the more flexible opportunities offered by extended work experience under the mentorship of practitioners. A debate is needed on whether learning is optimal in this environment or whether there needs to be the introduction of structured self-paced learning. This debate must take account of the impact on programme management of self-paced learning as where this has been introduced it is shown that innovation needed structural support (Brooks & Brooks, 1993). However, it is stressed that the programme (including timetables, deadlines) should support learning, rather than make the job of administration an easier one (Duckworth, 1987).

Table 4.4: Qualities and characteristics of academics

	Academics are adequate/excellent		
Lecturers generally...	**Student** (N: 85)	**Practitioner** (N: 29)	**Academic** (N: 12)
Show respect	97%	96%	100%
Respond with empathy to concerns raised	81%	83%	91%
Interact well	91%	96%	91%
Include others in decisions	70%	70%	100%
Listen to the opinion of others	83%	65%	73%
Respond to the opinion of others	80%	74%	73%
Make decisions through negotiation	76%	74%	82%
Motivate others	79%	78%	73%
Empower people	60%	74%	91%
Help others to help themselves	74%	87%	73%
Support and encourage students to reach own goals	72%	87%	91%
Provide appropriate and valuable feedback	73%	70%	91%
Provide timely feedback to students	69%	61%	73%
All students given the same amount of time to learn the practice of radiography	27%	18%	75%

4.3.3 Learning as enrichment

Universities of Technology have moved closer to 'traditional' university education since degrees were introduced in 1995 (Chand & Misra, 1999). They have revised curricula, including the introduction of integrated generic competencies, to become more than vocational institutions. This broader education supports the idea of learning for personal enrichment, which was a theme that came through in different ways in the survey. One student felt the benefit of 'learning to live in the world' (QS/82) while another felt that radiography has helped her to 'deal with pressure' (QS/68).

Radiographers' practise in a rapidly changing and complex world. It is education that must guide us as radiographers towards knowing where we want to go and what we want to be (Bruner, 1986). This education is about learning as growing such as the academic who wants 'to help students grow as people and professionals' (QA/5); the student who is able to 'rectify their own mistakes even out of radiography' (QS/64); the practitioner who responded to a question on generic life skills, saying that radiography has 'made me a strong person towards life' (QP/3); and an academic who has 'learnt to be always interested in new developments' (QA/1).

4.3.4 Are South African Radiographers life long learners?

The general opinion was that the radiography programmes develop the skills for radiographers to become life long learners (Table 4.5). This is consistent with life long learning as a strong theme for programme design in a technologically advancing field. Open questions required respondents to engage in future-oriented thinking, in particular the skills and knowledge needed to keep up to date as well as to grow and develop the field of radiography. Academics mentioned the struggle to keep up to date with new technology and the increasing volume of information. Still the steadily growing number of academics in South Africa with higher degrees and publications is tentative evidence of a positive approach to life long learning. Practitioners value being able to 'continually develop as a person and professionally' (QP/6) and appreciate 'on going education' (QP/18) opportunities in radiography although with the general perception that education needs to be 'offered' and is not something one does for oneself. In the student group respondents 'struggle with scientific writing' (QS/79) but know this 'provides scope for further education' (QS/5) and that they need the skills to 'work in different environments' (QS/49), 'always learn new things' (QS/59) and 'keep up to date on info' (QS/81). These and other responses indicate a desire to continue learning and recognition that this as an important part of being a professional.

Table 4.5: Students are equipped for life long learning

Academics (N: 12) agree	83%
Practitioners (N: 28) agree	80%
Students (N: 87) agree	84%

There are a number of meta-cognitive skills, which form the basis of the ability for life long learning (Boud, Cohen & Walker, 1993). Probably the first of these basic skills is what Gardner (1983) calls 'intrapersonal' knowledge, that is an awareness of one's own strengths and weakness as a learner. All cohorts agreed that students determine their own strengths and weaknesses (Table 4.6). The student opinion on this was very strong.

Table 4.6: Students determine their own strengths and weaknesses

Academics (N: 12) agree	75%
Practitioners (N: 28) agree	70%
Students (N: 90) agree	91%

A second basic skill for successful life long learning is the ability to manage one's own learning and to confront one's opinions and ideas with those of others in a dynamic personal and professional development of self (Bourgeois & Nizet, 1997). The opinion of most respondents is that student radiographers do manage their own learning in the academic environment (Tables 4.7). The opinion is however not strong for students and weakly positive in the practitioner group. Practitioners seriously doubt the student radiographers' ability to manage their own learning in the clinical environment (Table 4.8). Students are also not confident that they manage their own clinical learning.

Table 4.7: Students manage their own learning in the classroom

Academics (N: 12) feel students can manage their own learning	83%
Practitioners (N: 28) feel students can manage their own learning	52%
Students (N: 90) feel they can manage their own learning	61%

Table 4.8: Students manage their own learning in the clinical environment

Academics (N: 12) feel students can manage their own learning	75%
Practitioners (N: 28) feel students can manage their own learning	29%
Students (N: 90) who feel they can manage their own learning	53%

Learning from experience is an appropriate but not an easy option for radiography as knowledge needed in the world of work is an integration of ideas, cognitive learning and experience (Walshok, 1995). To succeed in learning from practice a person must have the ability to reflect on their own practice (Schön, 1983, 1987, 1995) and gain knowledge through 'situated learning' by engaging in a 'community of practice' (Lave & Wenger, 1991). This is an environment of life long learning and the opinion of the respondents is that students are generally well prepared for life long learning through the radiography programmes but with opportunity for improving this (Table 4.5) as we grow to understand what life long learning really is and how it is inculcated.

4.3.5 Difficulties with changing the learning environment

Educational change through changes to pedagogy is difficult and needs to be managed. A phased or 'stepped' approach can be more effective than radical change and Trowler & Cooper (2002) argue for 'enhancement' of teaching and learning regimes, rather than for a 'best practice' approach in which history and tradition is discarded. If there is insufficient support for independent learning (such as reading material, on-line resources and suitable spaces for peer learning) students are likely to complain, and demand the return to old practices - such as 'go[ing] back to REAL LECTURES with REAL NOTES' (QS/48). Without support for deep learning, rote learning will be more appealing (Gagne, 1970).

Hence sufficient resources are needed for independent learning (Brown & Smith, 1996), or students will demand prepared handouts and notes. Some students may resent having to take responsibility for their own learning, such as the student who considers that lecturers are 'laying too much responsibility on students' (QS/80). Thus, the building of students as independent learners, and enabling them to learn with 'thoroughness' (QS/12), as one student put it, places particular demands on educators. When educators are no longer the sole source of information, other forms of resources and provision must take their place. The development of a learning environment that fosters independence does not mean that teachers abandon their students, but it means that the need for guidance and direction is different.

4.4 What South African radiographers say about generic competencies

Consideration of what is said about generic competencies contributes to answering the research questions: what is the nature of radiographic knowledge, what curricular options facilitate radiographic knowledge and is the ILC an appropriate curriculum for Radiography?

General questions about how best to include generic competencies into the radiography programme indicates a strong opinion that they are effectively developed when taught in combination with radiography information and competencies rather than when taught separately (Table 4.9). However, some thought that at least some generic competencies could be effectively developed either in combination or separately. Opinion on whether generic competencies are in fact integrated in the radiography programmes varies. This can be understood in terms of the academics' awareness of higher education change and the need for the inclusion of generic competencies. Students are not always aware of the elements of a curriculum and practitioners are unfamiliar with the concept of generic competencies. If the academic opinion is an indication of the aim of radiography programmes in South Africa, the student and academic opinion could be interpreted as indicating that the aim is not always successfully achieved.

Table 4.9: General questions about generic competencies

	Agree and Strongly Agree		
Statement: Generic competencies are...	**Student** (N: 89)	**Practitioner** (N: 27)	**Academic** (N: 12)
effectively developed if taught separately	56%	43%	33%
effectively developed when taught in combination with radiography knowledge	85%	85%	92%
taught together with radiography knowledge	67%	50%	83%

4.4.1 Generic competencies integrated into radiography

The data from the question in which respondents were asked whether or not they felt particular generic skills were developed during radiography education are presented in Figure 4.1. This allows for comparison between the opinions of the three groups. In all cases the academic cohort has a higher percentage of respondents who are of the opinion that the generic competency is developed during the education programme. When considering individual competencies all groups indicate that computer literacy, communication skills and information resourcing are developed. There was consensus that numeracy is not developed and a fuller understanding of the need for and place of this skill is needed to know whether this is a deficit in the radiography programmes or not. It is concerning that 58% of academics, 32% of practitioners and 27% of students surveyed; consider that scientific writing is developed. This concern is further confirmed by narrative data that identifies academic literacy as a major weakness of the radiography programme. Cultural awareness is critical to transformation in South Africa and therefore the relatively low percentage opinion on inclusion is surprising.

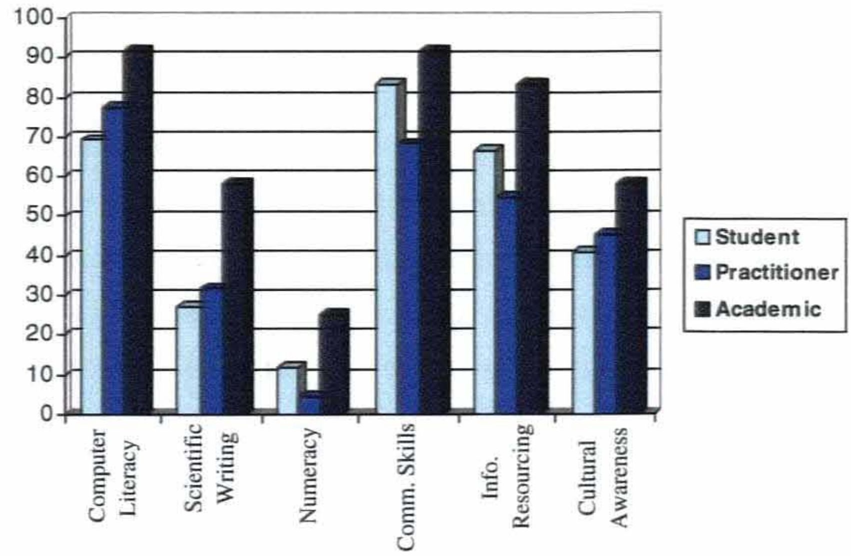


Figure 4.1: Opinion on the generic skills developed in radiography programmes

The qualitative data about radiography as a career and personal hopes for achievement through radiography highlighted an extensive list of generic competencies, or 'life skills' (QA/10), with remarkable consensus between groups. They are, therefore, presented without a comparison between groups and clustered into broad categories of personal attributes, interpersonal skills, societal awareness and professional competence.

Personal attributes

- Self-management

This includes competencies such as time management, 'self-discipline' (QP/16) and the ability to 'make quick decisions' (QS/52). Responsibility was cited frequently and emerged as the key component of self-management. It was seen as essential; 'the more responsibility is given to the student, the more effective the learning is' (QA/12) and at times seen as a real challenge; 'some practitioners are afraid of the responsibility...like not having enough confidence' (QS/89). Self-management and responsibility were often linked with independence and professionalism. Independence being at times work related and at other times connected to independent thinking, while professionalism was always mentioned in connection with the practice of radiography and in this study was identified as a separate category.

- Maturity and Self-confidence

Maturity was frequently listed; 'developed into a mature, better person' (QS/69); usually without explanation of what is understood by being mature but connected to achieving 'a mature and strong personality, one that will aid me through life' (QS/72). Developing self-confidence or being a 'strong person towards life' (QP/3) was a component of maturity and linked to a sense of self-worth. Several respondents listed this as a benefit of being a radiographer.

Interpersonal skills

- Communication and Relationships

The benefit of learning to communicate with colleagues, the public and patients was indicated as very important as radiographers learn 'to be competent and trusted with patients and others in the hospital' (QS/80). This is in agreement with the main theme of Abbott (1988) that professions do not function separately but they relate in an interdependent system of cooperative and competitive relationships. Relationships need affective skills and sensitivity to others with many qualities and characteristics emerging in this study such as; sympathy, empathy, caring, respect for others, confidentiality, helping people and understanding people and their needs better.

- Teamwork

Integrated patient care has become a new role for health practitioners. In radiography this is an extension of the previous notion of patient care limited to the radiographic procedure (Kowalczyk & Donnett, 1996). The National Health Council (2005) extends this vision to a health care system integrated across time, place and professions to deliver patient-centred care for the duration of life. The interdependencies of all involved are recognized as promoting a continuum of care through teamwork. Respondents identified the importance of working as a team and in a team such as the student who feels that radiography is a chance to 'be part of the medical team and contribute to patient management' (QS/12).

Societal awareness

- Cultural awareness

There was a pervading awareness of culture expressed by respondents; 'helps me to deal with different cultures and how to live with them' (QS/64), 'learnt to appreciate people and cultures' (QP/7), gaining 'insight into other peoples attitudes' (QP/22) and 'to learn about different types of people and understand why we are different' (QS/38).

- Citizenship

Many respondents took helping and caring from the level of the individual patient to wider applications of community and society; 'a means of serving my community' (QS/25, QP/29), 'service to humanity' (QS/19), 'become a valued member of society' (QP/10) and 'being helpful in the world' (QS/16). Mention of citizenship focussed on being a South African, 'be obedient servants of the law of South Africa' (QS/74) and was interestingly attributed to the formal instruction more than to workplace learning. The promotion of citizenship is achieved by work experience beyond the confines of clinical practice and as a cornerstone of the service learning initiative in South Africa (Hay, 2003) learning through community partnership (Connors & Seifer, 1997) is growing in higher education.

Professional competence

- Professionalism

Professionalism comes from professionalizing radiography, which needs learning, development, change and learning professicnals (Simons & Ruijters, 2004). This is a process of learning through reflection on practice, involvement in research and developing the professional knowledge base of 'the profession' (QA/1) that the academic cohort spoke of promoting and 'my' (QS/47), 'your' (QS/76), 'a' (QP/12) profession frequently referred to. It is professional practice through reflecting and intervening as moral agents (Sullivan, 2004; Munson, 1996) and the acknowledgement that the breadth and depth of the vertical and horizontal knowledge (Bernstein, 1999) is necessary in radiography. A profession involves a social relationship of engagement in a community of practice (Lave & Wenger, 1991) with a specific knowledge base and function (Jarvis, 1999b). Respondents often used the word professionalism without explanation but frequently linked it to such qualities as, integrity, ethics, morals, principles, responsibility and leadership or to notions of practice as 'a valued member of society' (QP/10) with 'an in depth insight of the medical world' (QS/1) that gives some notion of their interpretation of being a professional.

- Problem-solving

A possible barrier to progressing from novice to expert is problem-solving (Hansten & Washburn, 2004). It is through experience that the expertise of reacting automatically to similar situations or observing accurately and determining the appropriate action develops. This is when expert knowledge can be activated as a whole while in the novice student; knowledge is activated as an active, conscious step-by-step process (Boshuizen, 2004). So the professional competence of being: 'able to handle any problem at hand' (QP/14), 'work independently and solve problems' (QA/2) emerged as essential by the 'expert' and 'novice' respondents. Problems were identified as belonging to the workplace but problem-solving was connected to critical thinking and seen as being developed mainly through classroom activities rather than in the workplace. Learning how to is the responsibility of the academy so that individuals can problem-solve in the workplace where it is an integrated competency not separate from practice.

- Contextual Competence

Radiographic professional knowledge was often referred to by the term, competence. This is more than repetitive tasks as was indicated by such statements as; 'train radiographers that will be competent to work in any department' (QS/8), 'the aim is to graduate radiographers who are competent and well equipped to face any situation' (QS/56), 'competent and qualified radiographers that can go to any institute/hospital and do a good job' (QS/66), 'competent, reliable students with self-confidence to handle any situation' (QP/16) and 'can apply principles in practice and deal with various situations' (QA/3). The ability to transfer knowledge and utilize generic competencies to work in a changing context is what I refer to as contextual competence. It is the competence of a practitioner who is adaptable, flexible and functions according to the needs of the context.

- Technological ability

Radiographers work in a high-technology field and the need to 'stay in touch with the technology happening around us' (QS/24) is recognized as essential and stimulating; 'new and up-dated equipment make the learning experience more exciting' (QS/74). However, the need for 'training institutions (to) have state of the art equipment' (QP/12) was balanced with acknowledgement that learning is promoted if 'there is old and new devices which make work more interesting and more understandable' (QS/89). This presumably because technological competence is promoted by the acquisition of basic principles that can be learnt most easily on standard equipment.

4.4.2 Generic competencies and Critical Cross Field Outcomes

The intention of Critical Cross Field Outcomes (CCFOs), as prescribed by SAQA, is to influence curricula so that all higher education learners are developed in the skills identified as generic (Du Pré, 2000). These generic competencies are outcomes such as problem-solving, teamwork and cultural awareness. While some are truly generic to all learners in all fields, some are partly generic as they reflect the differences within a discipline. In this way there is problem-solving that is specific to the radiographic practice environment. A correlation of generic competencies emerging from this survey and CCFOs further develops understanding (Table 4.10).

It is evident that all the generic competencies identified, in this study, are incorporated in the CCFO categories. However, there are two CCFOs that are not evident in the survey data. These are responsibility for the environment and entrepreneurial skills. The former is possibly implied but radiographers seem not to be consciously aware of the impact of science and technology on the environment and their role in the responsible use of technology. Raising awareness about the environment as relevant to health in general and radiation medicine in particular seems indicated. Entrepreneurial skills do not enjoy a high profile in radiography in South Africa and this impacts negatively on the economic development of this professional group.

Table 4.10: CCFOs and opinion on generic competencies for radiography

SAQA listed CCFOs	Generic competencies for radiography
Identify and solve problems	Problem-solving
Responsible decisions	Management, responsibility
Critical and creative thinking	Independent thinking, transferable skills
Work effectively as member of a team	Team work
Information literacy	Information seeking and research
Self-management	Independence, learning about life & life skills, self-development, self-management
Effective communication – oral	Interpersonal skills, communication
- written	Academic literacy
- scientific	Information seeking and research, Academic literacy **(weakness)**
Effective use of science and technology	Technological ability, keeping up-to-date
Responsibility towards environment	
Responsibility towards the health of others	Affective skills, promote health
World knowledge	World view
Personal and society development	Self-confidence, maturity
Explore learning strategies	Self-directed & independent learning
Responsible citizen	Community awareness & involvement, professionalism, citizenship
Cultural sensitivity	Cultural awareness, sensitivity to others
Explore education & career opportunities	Life long learning, research, further studies
Develop entrepreneurial ability	

4.5 Funding Radiography education

Opinion on teaching and learning and desired changes can be further understood through the questions on infrastructure that includes reference to whether increased expenditure is needed and how this would be spent. It is not surprising that all groups want more money spent on radiography education (Table 4.12).

Table 4.11: Expenditure on Radiography Education

Statement	Student (N: 91)	Practitioner (N: 29)	Academic (N: 12)
Yes more money is needed	96%	92%	92%

What is of interest are some of the suggested items recommended for additional funding (Figure 4.2). There was agreement that no further expenditure was needed to employ more lecturers or provide additional computer access for lecturers. Student access to computers was the most pressing need identified by 83% of students and academics. The fact that even 50% of the practitioners cited this as worthy of additional funding indicates the strength of the opinion on this matter. Up-grading technology in the classroom was important for academics and reasonably important for students. Information resources are essential to teaching and learning particularly where student centred learning is promoted. The fact that 82% of students want more information resources could point to them knowing the value of taking responsibly for their own learning. This is supported by the qualitative data where comments indicate that students want to learn for themselves but need easy access to good resources to achieve this. The fact that 50% of academics and practitioners identify resources as a need for additional expenditure does not translate to these groups not recognizing the value of information resources. Rather what emerged from the qualitative analysis is that they hold the opinion that information resources already available must be optimally used before more money is justified in this area.

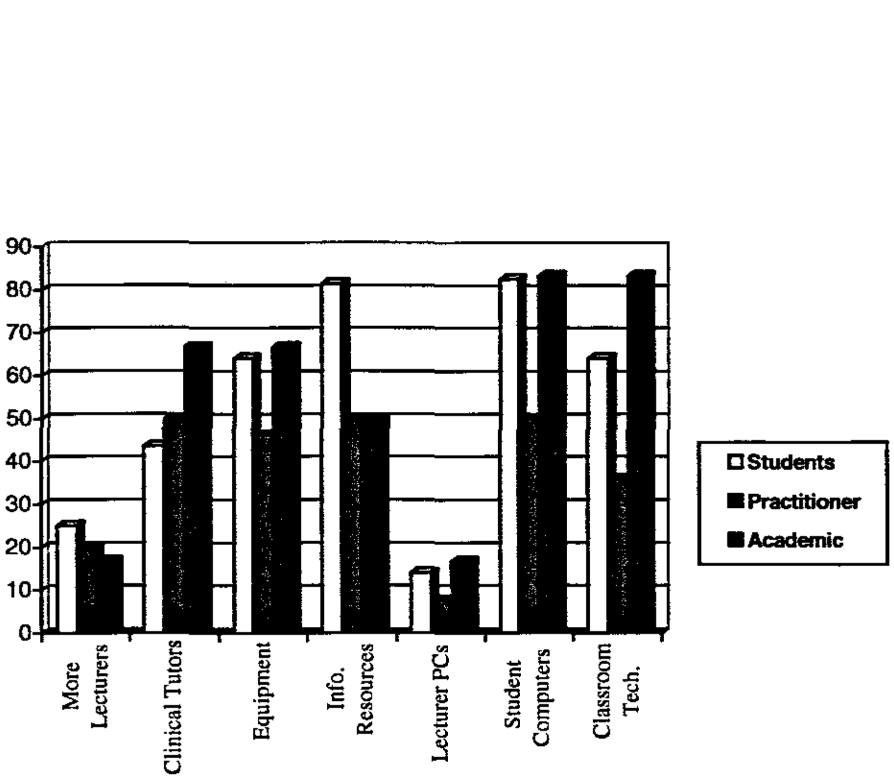
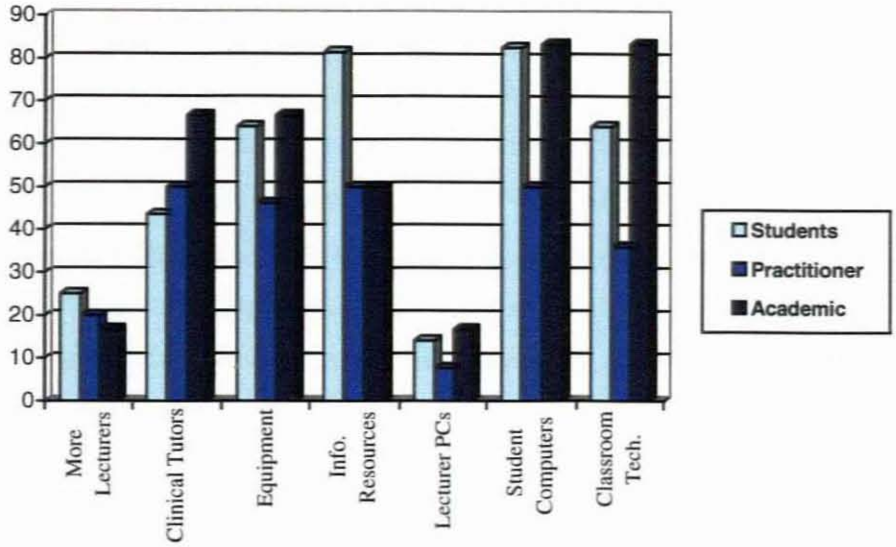


Figure 4.2: Opinion on increased expenditure in radiography education

Quality teaching and learning needs regular access to good general equipment and access to modern, high technology equipment. In particular the practitioners appreciate the value of the fundamental principles of radiographic practice that are learnt by doing general radiography on standard equipment while students want access to the latest and most advanced technology. With regard to clinical teaching, there was consensus that more clinical teaching and learning is needed. There was however variation on how this is best facilitated. Students seem to want clinical teaching to be conducted by the practitioners and not by permanently appointed clinical tutors. Practitioners are divided between wanting more clinical tutors and recognizing that the academics and the practitioners could do more clinical teaching. The academics also want more dedicated clinical tutors but at the same time support more structured clinical teaching by the academics and practitioners.

4.6 Does an integrated curriculum suit radiography?

The responses were not canvassed for an integrated curriculum. Hence no questions used the words 'integrated curriculum', 'integration' or 'integrated' in order to avoid leading the respondents. Yet the 'voices' of academics,



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4.6 Does an integrated curriculum suit radiography?

The responses were not canvassed for an integrated curriculum. Hence no questions used the words 'integrated curriculum', 'integration' or 'integrated' in order to avoid leading the respondents. Yet the 'voices' of academics, practitioners and students captured by the instrument of a national survey, support the idea that an integrated curriculum is appropriate for radiography education. Statements recommending that students 'work more practically in lectures' (QS/36), as well as frequent use of the terms 'integrated' or 'integration' were linked with suitable pedagogies for radiography and support the notion that the workplace should be a key influence on the curriculum. Generally the data supported an integrated approach to curriculum renewal, recommending areas in which such innovation was necessary, and areas in which some retention of traditional teaching pedagogy in traditional spaces was advised. There are many ways to introduce integration into a curriculum and the ILC is but one example of an integrated curriculum. Aspects of integration that surfaced in the survey will be discussed here and have also contributed to Chapters Five and Six, which develop a framework, criteria, and typology for an integrated curriculum from learning through the Radiography ILC.

4.6.1 Integration of theory and clinical practice

All groups frequently cited the integration of theory and clinical practice as critical to a radiography curriculum. Curricula which attempt to narrow the gap between theory and practice can be described by two designs: 1) programmes where there is planned integration of academic and workplace knowledge (Prince & Boshuizen, 2004), and 2) programmes where there are scheduled workplace opportunities to develop expertise (Ropo, 2004). The opinion was that *learning* is the most important reason for students being placed in the workplace (Table 4.12). The strong practitioner opinion is surprising, as there does not appear to be consistent translation of this opinion into learning as a priority in the day-to-day functioning of the departments where service is obviously the priority. Some practitioners marked both options as important and some students and academics indicated uncertainty and could not therefore be counted into either option. This can be understood as recognition that student radiographers enter a community of practice (Lave &Wenger, 1991) and develop expertise through authentic work

4.6.3 Optimal learning towards clinical competency

Table 4.14 presents information on professional learning. There was strong consensus that student radiographers learn most during the work placement. This supports that learning to do is far better achieved through doing than through learning about doing (Wissenschaftsforum Bildung und Gesellschaft, 1998). There is also positive opinion that the practitioners are the key to students' achieving clinical competency. While students also value the contribution of the academics to their clinical practice learning, the academic group appear not to consider themselves very important.

Table 4.14: Aspects of learning for radiography programmes in South Africa

Agree or strongly agree that student radiographers...	**Student** (N: 86)	**Practitioner** (N: 29)	**Academic** (N: 12)
learn more from work placement	97%	100%	91%
depend on lecturers to learn clinical skills	61%	48%	30%
depend on practitioners to learn clinical skills	87%	96%	83%

4.6.4 Structure of integrated programmes

Data presented in Table 4.15 aids understanding of opinion on curriculum structure. Opinion indicates that both subject-directed and integrated curricula are used in South Africa. Student opinion indicates that there is a common focus within subjects (73%) and thematic teaching to connect subjects (83%). This is indicative of the presence of integrated approaches. Yet 65% of students consider that radiography programmes are mostly subject-based, possibly explained by the need for registration by subject in all radiography programmes. The findings from the academic group indicate that in some programmes there is an effort to plan for integration in the curriculum. Practitioners do not, for the most part, recognize integration. If the theory-practice gap is narrowed by authentic, real life scenarios (Prince & Boshuizen, 2004) then the student opinion (81%) offers some hope but the practitioner opinion (48%) and even more so the academic opinion (33%) indicates that further investigation is needed.

Table 4.15: Aspects of radiography programmes in South Africa

Programme design is mostly that...	Student (N: 91)	Practitioner (N: 29)	Academic (N: 12)
subjects taught separately	65%	46%	42%
a common focus in subjects at a particular time	73%	44%	75%
common content of each subject coincides	68%	50%	58%
shared planning and teaching for overlap	58%	24%	58%
one lecturer teaches where overlap exists	38%	35%	50%
thematic teaching connects subjects	83%	30%	50%
learning focuses on real life situations	81%	48%	33%
There is team planning by lecturers	59%	26%	42%

4.6.5 Beyond integration of theory and practice

The survey of opinion on the status of radiography education in South Africa in the year 2003 supports the interpretation that the key influence on higher education curricula is employment. To ensure that radiographers exit with a qualification entrenching the internalisation of relevant information that can be applied as professional knowledge and competence, essential to success, there must be more than the offering of theory and the opportunity for practical experience. Generic competencies must also be integrated into a learning centred curriculum. Generic competencies integrated into the radiography programme aid the acquisition of skills, allow spaces for interdisciplinary learning (Fogarty, 1991) and develop self-directed learners who retain professional currency to enhance success as a member of the health care team. The value of an eclectic approach that includes a variety of methods was acknowledged as preferable to a single 'good' pedagogy. It prevents a student facing an entire programme that is disliked, uncomfortable or does not facilitate their individual learning. The ILC is one example of curriculum transformation in response to the changing context. This curriculum is an eclectic approach that promotes integration and learning. The impact of this is that integration in the curriculum has been encouraged and facilitated without those involved necessarily understanding explicitly about curricular integration, or identifying the 'ideal' Radiography curriculum as an integrated curriculum, or without fully understanding the implications of transformation to such an integrated curriculum.

5. CASE STUDY OF AN INTEGRATED LEARNING CURRICULUM

> During the last quarter of the twentieth century universities around the world found themselves under increasing pressure to change the way they operate. Alert universities gradually recognised that they had to respond to proliferating new demands of government, industry, and societal groups, while maintaining and improving their traditional fields of research, teaching, and student learning that became more complicated with every passing year. Whatever their heritage, or individual traditional character, the pace of change dictated a more flexible and adaptable posture (Clark, 2004/5: 1).

5.1 Introduction to the case study

Chapter five presents and interprets data, at the local level, from the case study of an integrated curriculum in radiography. First, there is descriptive data to introduce the environment of the case study. This is followed by what was learned about radiographic knowledge, teaching, learning, assessment and curriculum development. Some identified problems are presented before the chapter ends with final conclusions.

5.1.1 The traditional Radiography curriculum

The three-year National Diploma in South Africa is structured on a subject-based National Syllabus. The first year, theory and clinical, is common to all categories (diagnosis, nuclear medicine, radiation oncology and ultrasound) though students can be selected into any of the categories. In the second year there is common theory with category specific clinical practice while the third year is entirely category specific. This forced commonality was generally not viewed as satisfactory and students indicated they wanted to learn from the perspective of their category only. However, there are areas of overlap in the radiography categories and other health science programmes and there is an interest in: 'more medical training' (SOC/12)[3]. Cost and time efficiency and development of depth and breadth were motivating factors for having students together whenever

[3] Students (S), Practitioners (P) and Academics (A) are referred to by a code that indicates the data collection event that the direct quote is taken from. For example SOC/12 represents student number 12 who completed an evaluation of the 'old curriculum. See Table 3.2 and 3.3 for a fuller explanation.

possible at CPUT; an institution that offers the four categories of radiography. Historically national and institutional structures entrenched a transmission mode, although innovation in the teaching and learning environment steadily increased as lecturers developed awareness and competence.

5.1.2 Winds of change

It might be that the rigid, non-creative education of traditional institutions is irrelevant for the context in which health care practitioners practise. Internationally, curricular innovation reflects changes in health care, and in scientific and technological advancement (University of Vermont, College of Medicine, 2003). In South Africa there was a policy of OBE (SAQA, 2000) and the persistence of a narrow vocational focus was seen as a barrier to student-centred education. Responses from the South African Radiography departments to these changes were varied. Locally a decision was made that the existing curriculum did not adequately fulfil the national requirements and fell short on the demands of professional education. OBE was seen as a pathway for developing a new curriculum, while retaining the strengths of the past. Hence there was a shift away from a lecturer in-put mode to a focus on the achievement of outcomes through a participatory, student centred approach.

5.1.3 Comparing the traditional curriculum and the ILC

This study is not a comparative study of the 'old' and the 'new' curriculum. However to guide the reader, Table 5.1 gives a brief comparison of the key features of the previous, traditional curriculum and the ILC.

Table 5.1: Comparison of key features of the traditional curriculum and the ILC

Feature	Traditional Curriculum	ILC
Pedagogical approach	Teaching centred Subject-based Syllabus/information directed and latterly outcomes directed.	Learner/learning centred Integrated Outcomes directed.
Integration of theory and practice	Student responsible for integrating the information relevant to practice.	Structured integration of information and practice to enhance integrated knowledge.
Teaching strategy	Directive, lecture style of teaching.	Facilitative style that focused on learning not teaching.
Learning strategy	Rote learning of presented information.	Self-directed, active learning.
Assessment strategy	Majority of written tests on subject information and clinical assessment through continuous assessment. Some innovative assessment by individuals.	Wide range of integrated assessment methods, including clinical assessment on a continuous assessment model. Planned connection of theory and practice.
Student guides	Lecture guides Lecture notes	Learner guides Guided reading lists, worksheets etc.
Classroom hours	Average of 640 lecture hours	640 hours of academic learning that included lectures, small group activities, self-study opportunities etc.
Group work	Essentially lecturing but some group teaching by individual lecturers with groups ranging from 2-15 students.	Increased, planned and structured group work with groups no larger than 10. Retention of some lecturing.
Clinical rotation	Not aligned to theory teaching.	Effort to align the classroom-based learning and clinical experience.

5.1.4 Improving learning from clinical practice

Although academics carry dual responsibility for academic and clinical outcomes much of the clinical experience is gained while student radiographers' work as members of the health care team, under the supervision of radiography practitioners. Students' learn through observation and practice, with a high percentage of learning taking place during indirect guidance. Thus, they need skills to learn from experience in situations where there is no teaching and success comes from reflective learning. Criticism of the previous curriculum included that there was a separation of clinical and theory components and that students placed in the workplace did not learn and 'know' unless they were permitted to actively participate in the work experience with mentoring. The academics looked for ways of bridging the gap between learning in the classroom and clinical practice through 'co-participation at work'; a way to understand the relationship between thinking, acting and learning that makes up knowing in the workplace (Billett, 2000). It is not sufficient to merely participate in the routine activities that are available and for 'knowing' to be maximised there were designed learning opportunities and active guidance in the workplace. 'Students must learn how to do (skill/techniques), why to do (use of theory to understand practice) and show understanding in how to use the skill (conceptualised knowledge)' (AG/6) through the dismantling of the separation between the academy and workplace. They would: '...learn to apply what you've learn(t) academically in the department and even what you learn in one department to another place (department) or different patient' (FGS3/3).

5.1.5 Changing assessment

Radiography assessment practices were guided by the subject-based national syllabus and were consistent with the transmission mode. Hence summative assessment in the form of written tests and examinations were common. Nationally this changed with the Higher Education Quality Committee's (HEQC) policy change to assessment-driven higher education. The intention was to widen access, improve success rates, and develop graduates who have knowledge, skills and attitudes appropriate to a developing society and growing economy. Assessment practices are integral to, and the generic indicator of, the quality of higher education programmes. In the light of national policy the local higher education institution developed a framework of continuous assessment, with a developmental approach, including a wide variety of formative and summative assessments of progressive complexity that includes integrated assessment tasks (Cape Peninsula University of Technology, 2004/5). This made integrated assessment a requirement, without the need to link it to an integrated curriculum structure. Assessment requiring more than rote learning and regurgitation grew steadily as the lecturers engaged with new educational thinking. There was the use of a variety of innovative assessment practices, including a portfolio (Engel, 1994) on a continuous cycle throughout the year.

5.1.6 The ILC: a response to contextual change

With a growing awareness of the limitations of the traditional, subject-base curriculum, a new curriculum was proposed that aimed to address the demands of OBE, beyond national requirements and institutional strategies. Its development and implementation depended on a committed team, their interpretation of the context of change being called for in higher education, and their translation of the needs of the modern workplace. On reflection the journey was a lonely endeavour travelled by a dedicated team of radiography educators, without the direct support of institutional infrastructure or guidance. The investment of energy and effort to change individual practice and sustain enthusiasm for curriculum renewal was a challenge. Below, I outline some of the features of the curriculum innovation that has been termed the 'integrated learning curriculum' (ILC).

From teaching to learning

Radiographers gain their identity from clinical practice in radiation medicine. Clinical competency is therefore an imperative, together with the need for theory-based knowledge. The shift that was identified as necessary was to move from the transmission of skills and information to the creation of learning experiences in the classroom and in the clinical environment that would enhance the acquisition of integrated and structured knowledge with direct clinical relevance. Learning was put at the heart of the change to facilitate the students' professional development by providing a knowledge base for rational problem-solving that allows good clinical reasoning (Dunaway & Faingold, 2001) and engagement in the radiography community of practice. The intended ILC emphasised the promotion of a learning environment for the development of integrated knowledge and integrated professional practice.

Reflective eclecticism

There was innovative pedagogy in the previous curriculum, but the unstructured way it was used did not enhance the sequential development of the student. Planned curriculum change was considered to be preferable to *ad hoc* interventions by some academics, or in some sections of the curriculum. The academics wanted a curriculum planned to promote the transfer of useful knowledge and self-directed learning in a supportive and structured environment. The ILC was an adapted curriculum in line with 'reflective eclecticism' (Posner, 1992) as no curriculum model was directly transferred from another context but rather there was adaptation to accommodate the circumstances of the particular context and the expertise of the academics.

Deciding on an integrated learning curriculum

The reasons for an integrated curriculum in radiography include many of the same reasons cited by Jacob (1989) and Benjamin (1989), such as the expanding body of knowledge that precludes continuation of the transmission mode; changes in society and state demands for higher education such as the compulsory inclusion of generic competencies; concerns about curriculum relevancy in the fast changing workplace of a rapidly developing technological field; and the negative impact of separating disciplines in a world that needs practitioners to be able to solve interdisciplinary problems.

Integrated curriculum is neither a single entity nor the lexis for all curriculum ills. Still the potential benefits envisaged, prompted change towards more integration than the previous attempts to connect theory to practice. Hence it was the degree of integration and change, rather than the need for integration and change that was negotiated within the academic team. PBL was a possible option but the increased time commitment of the academics, in a department that was already facing possible staff reduction, and practitioners, who already voiced discontent at their teaching time commitment, was such that a pure PBL approach for the entire programme was not considered feasible. A curriculum that encouraged each academic to plan learning activities for problem-solving and skills development, including small group work with focussed problem-solving, and where the academics remained in close contact with the students, thereby enhancing the student to academic relationship and allowing the academic the opportunity to properly assess student learning (University of Vermont, College of Medicine, 2003) was considered appropriate.

Negotiation for change

The fact that student radiographers need simultaneous access to higher education and the workplace means a collaborative partnership between employer, educator and student is essential. Negotiation in the 'transaction spaces' (Nowotny, Scott & Gibbons, 2001); occupied by those involved, is necessary and the key to successful curriculum renewal. The Advisory Committee with higher education, and employer representation, is an example of such a 'transaction space'. Other spaces are student meetings, clinical department meetings with academics present, and *ad hoc* joint meetings between practitioners and academics to discuss curriculum issues. A good partnership assists student radiographers to develop a professional identity as they move between the two worlds. The workplace component increases until the student no longer straddles two worlds but enters the world of work as 'qualified' (Figure 5.1).

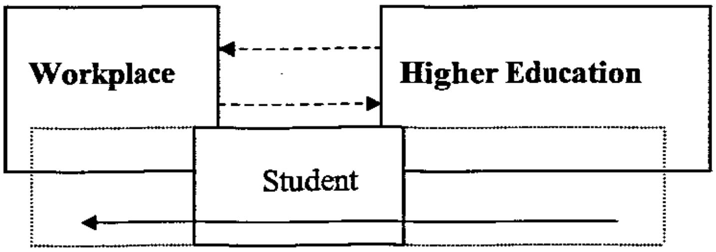

Figure 5.1: A Conceptual Model of the ILC

Phased implementation

There are potential benefits from planning an entire curriculum of a qualification before implementation but this privilege was not an option for the ILC. The implementation of the ILC was phased in from the 2001 student intake so that by 2003 the three levels of the National Diploma in Radiography were operational, and by 2004 the three-year diploma could be reviewed and revised. This is in line with Fullan & Miles's (1992) advice that sometimes the use of partial solutions that act as building blocks towards the bigger goal, is a better option. The time and effort of the academic team was increased because of the need to manage two curricula as one was phased out and the other phased in. However, the simultaneous long-term programme planning, medium term planning for each level, and short term planning for each section, allowed for flexibility and accommodated the unexpected (Wallace, 1992) within a guiding framework. Also the more gradual change enabled fuller participation as motivation grew and the fear of letting go of familiar pedagogy receded. Shared ownership increased as curriculum functions were progressively taken on by team members.

5.1.7 Contextual challenges to curriculum renewal

The dynamic nature of curriculum, which resides in a changing world, meant that the unexpected changes within the context impacted on the ILC as it was implemented. Four changes, resulting from external forces, which were not anticipated at the commencement of the study, are discussed for the particular challenge they presented to the radiography curriculum at this site. The two imposed decisions were that student radiographers in this province would no longer be paid a salary and community service was introduced through National Health Policy. The two chosen changes are that ultrasound radiography was offered at diploma level for the first time and service learning was initiated at the local radiography site.

The challenge of technology

Technological advancement has resulted in an expanding scope of practice as new technologies enter the field of radiography. Ultrasound imaging is a technology that has entered the scope of practice of medical doctors, nurses, clinical technologists and radiographers. In South Africa ultrasound imaging was in the professional scope of diagnostic radiographers who gained competency in the use of this modality through in-service training or a certificate course. The 1993 revision of radiography programmes meant that ultrasound could be offered as a three-year diploma directly upon entry to higher education or as an additional two years after completion of another radiography category. In 1995 the latter option was introduced in the Western Cape as a two-year degree. In 2003 the option of a first diploma was added. Thus, when the ILC was implemented in 2001 there were no students in the ultrasound category of the first year although ultrasound was included in the curriculum to meet the inter-disciplinary learning needs of students in the other categories. From the 2003 intake, curriculum revision needed to accommodate first year students in the ultrasound category. This impacted on the curriculum renewal process.

A radiography curriculum resides in a world of technological advancement. The curriculum must develop and adapt to address new areas as they emerge. This is the challenge of the future for the ILC and the introduction of an ultrasound diploma is but one example of such adaptation.

National policy on Community Service

Within the country there has been the movement of radiographers from public hospitals into the private sector. In addition the re-entry of post-apartheid South Africa into the global market and the fact that radiographers are a scarce resource worldwide has resulted in many radiographers leaving for employment in developed countries. This has depleted the pool of qualified practitioners to the extent that training is unable to keep pace with the need. Compulsory service for newly qualified practitioners was one solution to maintaining the health service in our state hospitals and to some extent balancing the cost of training. Community Service was first introduced for Medical Doctors (Department of Health, 1998) and was later extended to include other groups including radiographers (Department of Health, 2002b). Implementation was rapid and the first notice in January 2002 informed students qualifying in December that they would commence their one-year of Community Service in January 2003 (Department of Health, 2002b). This presented a real challenge for the first group who were resentful that they were not warned well in advance and were obliged to complete the year of service before achieving registration status as independent practitioners with the Health Professions Council of South Africa (HPCSA). However, the majority of students shifted quite quickly and were excited by the prospect of going to new places to serve the communities of South Africa. The positive experiences of the first group helped the process of acceptance by the next group, the first student cohort of the ILC.

The academics perceived a benefit of developing well-rounded practitioners through guaranteed employment immediately after qualification. They were aware that, because Community Service provides health care practitioners in areas where there are shortages (Thom & Cullinan, 2001), many would now work alone in small peri-urban or rural facilities early on in their career. The ILC would need to develop more clinically mature and clinically autonomous practitioners than was necessary for the supportive environments of the past.

National demand for Service Learning

In 2004 the study site agreed to be included in a Community Higher Education Service Partnership (CHESP) pilot programme. The aim of this Service Learning project was to encourage learning through service to the community. The opportunity for real world learning beyond radiography was compatible with the request by many students:

> Exposing students to different environments, giving these students the opportunity to work in neighbouring hospitals or even other places that are not radiography... creates awareness of what happens at other places and they gain more experience (RWS03/8).

Service Learning is consistent with and strengthens integrated learning and provides a tangible opportunity for the convergence of higher education and the real world.

> A service learning project is a structured activity that is designed to meet community needs and at the same time to contribute to the learning experience of the student. This means that while you are delivering a service to the community we will plan the experience to contribute to your learning as radiography students...Service Learning is integrated into the curriculum... (CPUT, Radiography Learner Guide, 2004).

The challenges for the introduction of Service Learning were that the tri-party partnership (community, student and higher education institution) demanded commitment that added to the workload, all parties incurred increased costs and there were implications for security. The benefits for the students were that they engaged in interdisciplinary experiences and had the opportunity to develop generic competencies such as cultural awareness, applied ethics, conflict resolution and critical reflection that facilitated a more extensive bridge between theory and the real world.

In the co-operative education model (Figure 1.1) the higher education institution is responsible for the education and training of radiographers in co-operation with the radiography workplace. Service learning extended the learning environment to include meaningful real world sites that are not necessarily traditional workplaces for radiographers, such as radiography students doing health and career education and establishing reading corners for children in impoverished communities (Figure 5.2).

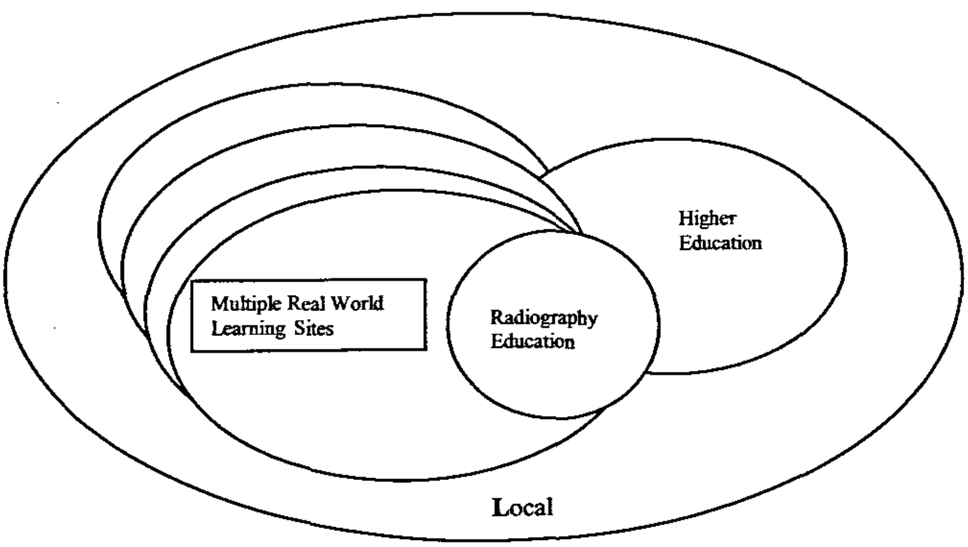

Figure 5.2: The learning environment adjusted for Service Learning

Educating radiographers for the high technology tertiary hospitals only would be inappropriate in a developing South Africa and responding to the demands of Community Service. Initiatives such as Service Learning demonstrate that the ILC is adaptable to local needs. It can prepare radiographers for the place of person power in a country with a skills shortage as well as for the high technology radiography world (Winberg, 2006).

Change in the status of radiography students

At the commencement of this research project the radiography student was both learner and paid employee. The status of radiography students in this province changed when the Provincial Government decided to withdraw salaries. In the workplace this meant a shift from paid employee with a service contribution to the student gaining unpaid work-related learning (Brown, 2000). The collaborative partnership between the academy and workplace must continue with sensitivity to service needs but with a shift in focus to learning centred work placement. This has meant things such as following the academic year for students but with the retention of a standard working week and after-hours duties that expose the student to the full range of clinical activities. In this way it is presumed that the discipline-based knowledge that can be judged by its claim to generalisable truth and practical knowledge that is judged by its performance in the workplace (Chappell, 2000) is not affected by the fact that students do not receive a salary. However, the social implications of no financial security during the period of study should not be underestimated and the effect of removing salaries should be evaluated.

I turn now to a detailed discussion of the findings from the case study in terms of radiographic knowledge, teaching, learning and assessment in radiography, implementing the ILC and problems encountered. The chapter ends with conclusions to guide radiography education and training in the 21st century.

5.2 What was learned about the nature of Radiographic knowledge?

In this section I briefly discuss the main findings of the case study, with regard to the changing nature of radiography knowledge.

5.2.1 Academic Radiographic knowledge

The greater part of the radiographic knowledge area is hard/applied knowledge. However, radiography draws on hard/pure disciplines such as Anatomy, Physiology, Pathology, Physics and Chemistry, pure/soft disciplines such as

Psychology and Sociology and soft/applied disciplines such as Communication and Management (Biglan, 1973). Bernstein's (1999) vertical knowledge represents the kind of knowledge that is based on traditional disciplines (hard/pure and pure/soft). In his model horizontal knowledge is typically acquired through experience, such as being a student in the world of radiography. Horizontal knowledge is the hard and soft applied knowledge that can be likened to knowledge gained through 'situated learning' in a 'community of practice' (Lave &Wenger, 1991). The distinction between pure disciplinary (vertical knowledge) or applied (horizontal knowledge) does not mean they are exclusive to the university or the workplace. Both types of knowledge are produced and transferred within and beyond the context of origin and can be found in both sites. In radiography, practice depends on vertical discipline-based knowledge as well as horizontal generic and practice knowledge, gained in the radiographic workplace. Radiographic knowledge needed to educate a radiographer can therefore be considered to be interdisciplinary knowledge. Together with the fact that radiographers practice in a rapidly changing high technology world, within a health care team, this means that the concept of the transdisciplinary 'supertechnologist' (Friedenberg, 2000) suitably describes the knowledge base of radiography.

The debate that took place in the environment of the ILC is whether basic sciences are necessary as knowledge building blocks. Some academics feared the fragmentation of disciplinary knowledge through integration. Others questioned that if this core of basic science knowledge was necessary, what exactly is core content, how is it identified and is it needed prior to other learning opportunities starting? There was no debate about the fact that radiographers need basic science knowledge but the tension remains unresolved as the whether this information should be delivered outside of the integrated themes or is adequately learnt through integration. Thus, even with consensus on the value of an integrated curriculum there is debate on whether it is the curriculum process, the content covered or concepts developed that is critical for the development of radiographic knowledge.

5.2.2 Clinical knowledge

In the process of gaining the clinical competence essential in radiography, the student must take on the identity of a radiographer. Experience in and understanding of the clinical context helps this. However, practice knowledge is not gained entirely in the domain of the workplace and relies on information and learning from the academy as well (Table 5.2). In the ILC practice knowledge leading to clinical competency was successfully developed in a partially managed learning environment. Clinical opportunities were integrated into academic learning from early on in the programme and as the student progressed, so the complexity of their clinical ability developed.

Table 5.2: Student opinion on learning that *only* takes place in the workplace.

Learning from world of work	Positive opinion (N: 64)
Competence in radiography practice	100%
Holistic care of the patient	80%
Interpersonal skills/Communication	42%
Equipment handling and care	41%
Teamwork	38%
Professionalism	38%
Problem-solving	14%
Integration of disciplines	9%
Personal management	8%

Learning in the clinical department is contextual, develops knowledge required for functioning as a radiographer and integrates learning: 'When you are able to see how what you are learning applies to what you will be doing when you qualify, so that what you are studying doesn't seem pointless' (RWS03/11). This facilitates the ability for knowledge transfer: 'When a practical as well as theoretical approach is taken you are able to apply your theoretical knowledge' (RWS03/11) and 'The very important thing is competence once you have finished your studies and be able to apply the theory towards practice so enjoy clinical because you can visualize the theory done or a patient done before and can understand it better' (FGS3/12).

Perkins' (1992) model, in combination with Enslin's (1998) concept of 'applied competence' and the Department of Labour's (1997) description of what assessable skills are relevant to the 'complex and dynamic context' (Vorwerk, 2002) help to direct the discussion of what is important for radiography practice:

Clinical ability

This is the ability to consider options, make decisions about practice in context, and perform radiographic tasks appropriately.

Clinical understanding

This implies an understanding of relevant theory linked to the radiographic task and insight about the 'what' and 'why' of radiographic practice.

Reflective clinical practice

Reflective competence enables students to link understanding to performance, to learn from practice, to adapt to change and the unforeseen, and to pass reasoned judgement on different ways to perform the task. This is the contextual how of radiographic practice.

The three areas of clinical knowledge outlined above comprise radiographers' professional competence, and represent the ability of a practitioner to respond appropriately to a diverse, changing and highly complex environment such that the transfer of knowledge is at the core of good practice: 'difficult to study one way and practice in another but not all hospitals have the same protocol...we must learn a way and adjust when working' (SOC/1). Reflective practice and knowledge transfer are key to life long currency in professional practice and necessary to overcome the problem of: 'the way things are taught in the class and the method of applying our knowledge in the department clashes' (SOC/1). Transfer does not happen automatically and: 'it is difficult to do these [examinations] from just book knowledge' (SOC/10). Still there were students who found that: 'some of the things taught in class do make life easier when you get to the department' (SOC/3), 'theory answers most of our questions as on why some of the things are carried out by radiographers in the department' (FGS2/1) and 'theoretical knowledge plays a vital role during clinical learning' (SOC/2).

5.2.3 Generic knowledge

The need to continue learning and retain currency in a fast changing high technology environment is facilitated through integrated curricula (Lake, 2003) and generic competencies (Holland & Leggett, 2000; Whittle & Murdoch-Eaton, 2004) that enable learning throughout working life (Cornford, 2000). The ILC responded to the need for the planned integration of generic competencies that would be assessed together with professional outcomes through integrated assessment.

Four fundamental objectives for adult learning are recommended as; 1) the ability to access information, 2) the capacity to express ideas and opinions, 3) the skills to take independent decisions, and 4) learning how to learn in a changing world (Boland, 2000). These are aligned to the findings of Dent, (2001) and are similar to the most important generic competencies that emerged from this research: self-directed learning, problem-solving and critical thinking.

Generic competencies in the ILC

SAQA stipulates the inclusion of Critical Cross Field Outcomes (CCFOs), for all higher education programmes in South Africa. There was sustained emphasis in the ILC on the integration of generic competencies into the professional education curriculum. The revision of the Learner Guides in 2003 reinforced this intention by the inclusion of a brief description of each Exit Level Outcome (ELO) showing the integration of generic and professional competencies. Table 5.3 is a correlation between the national CCFOs and information on generic competencies in the level one learner guide of the ILC.

Table 5.3: Correlation of SAQA CCFOs and generic competencies in first year

SAQA listed CCFO's	Generic competencies in the level one Learner Guide
Identify and solve problems	Problem-solving (ELO 3). Identify faults and problem-solving (ELO 5).
Responsible decisions	Decision making (ELO 3)
Critical and creative thinking	Critical 'reading' (ELO 3)
Work effectively as member of a team	Team work (ELO 1)
Information literacy	Access and utilize information. Identifying, planning and organizing information and research (ELO 3)
Self-management	Time & stress management (ELO 3)
Effective communication - oral	Verbal (non-verbal) communication (ELO 1)
- written	Academic writing (ELO 3)
- scientific	Oral and visual presentations (ELO 3)
Effective use of science and technology	Highly technical equipment (ELO 2)
Responsibility towards environment	Clean & Safe environment (hygiene, general safety & radiation safety) (ELO 2)
Responsibility towards the health of others	Understand Health Care system. Holistic patient care. (ELO 1)
World knowledge	
Personal development	Personal growth eg leadership, interview skills (Optional and compulsory workshops)
Society development	Service learning eg health and career education to schools and health information in the hospital.
Explore learning strategies	Independent learning (ELO 3)
Responsible citizen	Professionalism, ethics (ELO 1)
Cultural sensitivity	Care for patients from all communities and cultures. Cross-cultural communication skills (ELO 1)
Explore education & career opportunities	Life long learning (ELO 3)
Develop entrepreneurial skills	

Generic competencies in radiography

The left-hand column of Table 5.4 tabulates the results of an exercise to identify the most important qualities and skills needed by a radiography practitioner from the perspective of a student radiographer with one year of clinical experience. The right-hand column correlates responses by the local student group in the national survey to the question: What knowledge and skills does a student radiographer need in order to be successful in their clinical placement/s? This indicates that students have awareness of the generic competencies needed for radiography practice.

Table 5.4: Radiographer Practitioner Skills Identified by Students in 2002

Second year students of 2002	All levels in 2003
Interpersonal skills	
General communication skills	General communication skills
	Listening skills
Writing skills	Writing skills
Verbal language skills	Verbal language skills
Non-verbal communication skills	Non-verbal communication skills
Ability to manage stress	Ability to manage stress
Caring	Caring
	Cultural sensitivity
	Respect
Leadership ability	Leadership ability
Personal management	
Time management skills	Time management skills
Attention to personal growth	Attention to personal growth
Professional skills	
Ability to work in a team	Ability to work in a team
Ability to work with people	Ability to work with people
	Ability to work independently
Ethical practice	
Professionalism	Professional practice
Empathy	Empathy
Ability to practice radiography	
Ability to deal with trauma, blood etc.	
Ability to cope with death and dying	
Desire to Work in a hospital	
Concern for radiation protection	
Financial planning	Financial planning
Management ability	Management ability

Study skills	
Effective study method	Effective study method
Library skills	Library skills
Ability to source information	Ability to source information
Referencing ability	Referencing ability
Self-study ability	Self-study ability
Life Long Learning ability	Life Long Learning ability
Thinking skills	
Problem-solving ability	Problem-solving ability
Ability to plan a project	Ability to plan a project
Ability to manage a project	Ability to manage a project
Ability to plan and conduct research	Ability to plan and conduct research
Cognitive skills	
Understanding of basic Statistics	
Knowledge of medical terminology	
Knowledge of patient care	
Knowledge about radiation protection	
	Ability to transfer knowledge
Technical and Psychomotor skills	
Handle complex equipment	Handle complex equipment
Careful handling of patients	Careful handling of patients

The perspective of students as to the most important generic competencies from those listed in the left-hand column of Table 5.4 showed consensus with the top ten items being selected by greater than 50% and up to 100% of a group of 26 students. In order of priority they were: 1) Use of complex equipment, 2) Communication skills, 3) Team work, 4) Empathy, 5) Sourcing information, 6) Radiation protection, 7) Patient care, 8) Problem-solving, 9) Professionalism and work ethic, and 10) Study methods. The generic competencies that were given less importance by the student group were scientific writing and personal development and the CCFOs not mentioned were world knowledge, development of society, exploration of learning strategies, citizenship, exploration of education and career opportunities and entrepreneurial skills

The two reasons that students give importance to generic competencies are: 1) They are required for the practice of radiography and 2) They are needed for success in higher education studies. While individual respondents cited a particular generic competency as important for the practice of radiography or for success in their studies all the generic competencies were cited as important for both reasons by the group as a whole. This confirms the appropriateness of integrating the learning of generic competencies into professional learning activities rather than teaching them as isolated skills.

5.2.4 Critical clinical reasoning

For the profession of radiography to be a consciously aware knowledge building community of practice there needs to be active reflection (Schön, 1983, 1987, 1995) by practitioners on their practice. In addition they need competencies for anticipative action (Beckett, 2000). The development of such thinking practitioners requires learning in authentic workplaces with real problems to solve and in a team of real peers (Beckett, 2000). Reflective radiographer practitioners will have the skills to become reflective researchers who generate knowledge connected to the dynamic experience of radiography (Hirsch, 2000a). They will enjoy the benefits of life long learning and develop radiography into a fully-fledged profession. An intention of the ILC was to develop critical and lateral thinking. It is likely that a student with the ability to think critically in the classroom will be able to transfer an adapted version of this skill and become a critically aware practitioner. Extending Schön's concept of reflective practice, based on the practical ability to move between theory and practice, I suggest the addition of a critical dimension. Critical and lateral thinking, combined with reflective practice, lead to what I term, *critical clinical reasoning*. This is the competence for critical reasoning in order to enhance clinical practice. Critical clinical reasoning is a generic competency essential in the clinical environment and is distinct from critical thinking or reasoning in any other environment. This competency allows the practitioner to continuously analyse and assess the clinical environment with a critical reasoning approach. It involves the ability to search for and measure evidence and transfer learning from this for adjusting professional practice.

5.3 What was learned about teaching, learning and assessment in Radiography?

The separations in this thesis are artificial separations to add clarity to the discussion. Radiographic knowledge, discussed in the previous section, is not actually segregated from teaching, learning and assessment discussed in this section. Teaching, learning and assessment are also interwoven and unable to be separated in reality. Hence while an attempt is made to retain the partitions for clarity, the overlaps that occur throughout the discussion indicate the connectedness of the information presented.

5.3.1 Teaching

The traditional curriculum focuses on the acquisition of information while the OBE curriculum is the application of integrated subject knowledge, skills and values (Van Rensberg, 1999). The ILC was the intentional integration of relevant discipline knowledge to achieve the programme outcomes, such that subjects as entities disappeared: 'They do not just teach one subject at a time but they try and integrate related subjects into each other' (QCS/23).

Previously there was reliance on the student to make connections between the information that was acquired through formal classroom teaching and its use in practice. Apparently they managed this reasonably well and became good functional practitioners. But the intention now, in higher education, is to give students the skills to make these connections more effectively and consistently so that their knowledge can be used in a variety of contexts and so that they can build knowledge: 'They want to make things link together so to make studies a little bit easy and understandable and so we use it in our clinical work and learn more ourselves' (QCS/64). It is through acceptance of the tension between knowing and doing that we are more aware of the complex needs in the education of radiography practitioners.

The ILC was a move away from a traditional curriculum with an emphasis on what the lecturer hopes to achieve, by delivering formal lectures from a pre-determined syllabus, to an emphasis on student achievement (Oliver, 1998). This needed a transition to a constructivist approach of being facilitators and managers of a student-centred, knowledge-producing environment (Monkman & Baird, 2002). To this end the students were informed that: '...your success depends on you being actively involved as a learner. You are responsible for your own learning. The lecturers are here to facilitate that learning process ...' (CPUT, Radiography Learner Guides, 2003/4/5).

Teaching for participation

There was recognition of the need for students to participate in their learning process: 'Not letting the lecturer only conduct the lectures, letting the students participate on the lecture. Giving everyone a chapter and letting that person conduct the lecture on that particular chapter...so the lecturer can assess the understanding of that particular student' (QCS/14). Students noticed that understanding was an outcome of active learning, 'Learning happens from understanding. Demonstrating an understanding for something is more important to me than parrot fashioned learning...understanding is because I do it and was not given it' (FGS3/4). However, time inefficiency and the increased effort of students learning for themselves meant that students often preferred lectures and at times academics could not resist the temptation to revert to lecturing: 'How do you balance the desire to maximize the learning with wanting to allow the student to learn and discover for themselves...it can take so long?' (AG/8).

Teaching for knowledge production

One academic summarized the curriculum based on a constructivist approach as; 'socially constructed knowledge through active learning by learners as they utilize their prior knowledge and experience to construct their own meaning and knowledge through a process of attempting to explain things they don't fully understand' (AG/3). In many learning experiences the promotion of active learning was unstructured and planning for the construction of knowledge was absent though there was generally an intention of promoting student involvement.

Other activities were structured as constructivist learning designs, drawing on the work of Gagnon and Collay (1999):

1. *A defined situation is explained*
A learning topic or system was selected.
2. *Students and materials are grouped*
Students grouped by category, experience or at times simply by their own choice. The material was grouped according to relevant knowledge.
3. *A bridge is built between existing and new knowledge*
Opportunity was given for students to express what they know about the topic.
4. *Active learning is facilitated through guided questions*
The academic facilitated the progressive gathering of knowledge on the topic.
5. *Students write or speak out their explanation of the defined situation*
Students were given the opportunity to conceptualise, visualize and verbalize their knowledge through discussion, communal drawing and writing.
6. *Students reflect on their learning through the shared explanations of others*
Experiencing expressions of knowledge and learning allowed students to construct their own knowledge and reflect on their learning.

Teaching through practice

Perkins' (1992) model of cognitive skills can be adjusted to describe radiographic knowledge in the clinical environment where the student:

Acquires *content knowledge* of facts, concepts and routine procedures of the discipline related to increasingly complex radiographic practice;
Learns *problem-solving* to solve typical and recurring problems from practice;
Gains *epistemic knowledge* of the rules of practice used in explanation, justification and problem-solving activities;
Learns through *inquiry knowledge* to reflect, challenge and construct limited new knowledge on practice.

Practicals can assist in the development of competence: 'Most of the time learners want to visualize what is being taught in class so it is a great idea to have some practical demonstrations to help them in understanding a lot more better' (FGS2/5) and 'Practicals in which we get to examine bones, radionuclide generators, etc. are helpful as we can get a 3D view of something which may be more difficult to learn off paper but very difficult to understand if only seen in the department (FGS2/7). Practicals are important to students because while they do not displace actual workplace learning they align with knowledge pertinent to practice. Students value the practice but not the theory of practice and see working knowledge as being more valuable than cognitive knowledge although a few realise that (most) 'aspects learnt in the classroom are somehow useful to students in the department' (SOC/12).

Teaching technical writing

Another problem is the difficulty of writing about practice: 'procedures are not easy to write on' (SOC/13) even if the student is competent in doing the task. It is during written assessments that the students are expected to write about doing and students favoured assessments where they could rather demonstrate practical ability. Practice is best learnt in an authentic setting and clinical assessment is optimised if conducted in the real world or simulated clinical setting rather than with written assessments. However, there is value in learning how to describe actions effectively in writing that will be of value in professional practice: 'When I study for a clinical examination it helps a lot when I put my actions onto paper. I numerically sequence the actions so that I organize what I am going to do before I do it. So when I am in the clinical situation I will do things in a structural, organized way' (RWS03/7). What is critical is that the skill of technical writing must be taught or the burden is enormous for students, particularly those studying in a second or third language. Hence the ILC included the teaching of writing skills appropriate to radiography.

5.3.2 Learning

Health care delivery in South Africa is structured on a traditional, specialty, model where radiography is a service driven, applied discipline that requires multi-disciplinary knowledge and trans-disciplinary practice. Students entering the radiography discipline need to learn to 'think like a radiographer' (FGP1/8). Thus, the ILC was influenced by the workplace and designed to facilitate appropriate learning for professional radiography practice with the goal of teaching connectedness and integration in order to overcome the teaching of separation and discontinuity which then leads to the fragmented learning of isolated knowledge unable to be applied (Humphreys, Post & Ellis, 1981).

Self-directed learning

On entry to radiography the majority of the students appeared to be somewhat versed in self-directed learning through their school experience. Of the group that commenced on the ILC in 2001; 24/26 (92%) indicated that they had learned something by teaching themselves, 20/26 (77%) stated that they had found information learned in the classroom to be of use in a different environment and 22/26 (85%) answered in the affirmative regarding the use of information in one subject/activity being of use in another subject/activity. Still all students had to be supported and guided to acquire the level of competency needed for the demands of self-directed learning in the ILC.

After experiencing the ILC, student opinion was overwhelmingly that each student should 'do more self learning instead of receiving a set of notes from lecturers' (QCS/23). They were aware that the ILC emphasised student involvement, 'students are given the work to do and by doing it themselves; they learn and are not spoon fed by lecturers' (QCS/4), 'it encouraged the learner to be more involved' (QCS/1), 'they want us to teach ourselves because that is what we will have to do anyway when we leave the course' (QCS/13) and 'I think that the method of teaching has changed to allow students to be more responsible for their learning and to take the initiative' (QCS/34).

Yet while students identified the major curriculum change as a way to stimulate student participation, and many students reflected on the value of active learning, they did not necessarily like the burden or appreciate having to be more involved and responsible as learners. In the three years, 57 students involved in the ILC responded to the question: Do you think the changes that encourage you to be responsible for your own learning have had a positive or negative effect? 49% responded that the change was positive, 35% that it was negative, 9% recognized both positive and negative aspects and 7% said they did not know. Negative impressions arose from the increased workload, student insecurity about the accuracy or relevance of the information when they found it for themselves and a preference for lectures with notes.

Learning theory and practice

Students easily identified integration as an intention of the ILC: 'we are integrating the work a lot better' (QCS/17). The majority of students understood integration to be the integration of theory and radiography practice: 'First the lecturers teach us the theory skills for a normal/ideal patient and then in the departments we don't always get the ideal/normal patient and learn there how to deal with it (variations). In theory we also learn the physics and working of the machine and in the departments we learn how to use the machine. Therefore both the lectures and departments are necessary' (FGS1/1).

There was consistent promotion of work integration by students: 'Having the practical side definitely makes it easier to relate a lot of the information to its applications and it's often easier to understand the information if I've already experienced a certain procedure, etc.' (RWS03/12) and 'When you see how things are done (in the department) that are discussed in class you learn' (RWS03/9). The integration of academic information and competencies needed for the practice of radiography in a modern workplace develops a unified professional knowledge base: '...you have to undergo theoretical as well as clinical training – *you have to learn to become a radiographer*' (RWS03/2). Integrated professional knowledge needs professional competence as part of the classroom learning: 'to put to practice what we learn in the classroom' (QCS/45) and academic learning in the clinical environment: 'Practical work makes you understand your theory' (FGS1/5).

The good fit between the academy and workplace learning was not immediately recognizable to students. Level-one students who had been on the course for six months experienced a partial link. Level two students recognized a strong connection between theory and practice but complained bitterly that the classroom learning did not exactly correlate with the techniques used in the clinical departments. Level three students appreciated that techniques varied between books and departments and while they too would like to learn only a single technique they knew this was not feasible as then they would only be equipped for one workplace. To achieve maximum benefit from an integrated curriculum the workplace and classroom learning have to be complementary and synchronized: 'It is impossible to know exactly what I learnt in the class and what I learnt in the departments but some things you just know that you would not have learnt if you did not go to class or to that particular department. You need both but they have to work together' (FGS2/6).

Active learning

Students find information that is useful and relevant as well as generic competencies interesting and when students are guided into finding things out for themselves this is more interesting than lots of lectures. Students 'like lecturers teaching the basics of the subjects and then asking students to read up more on that' (QCS/14). Students also wanted to 'see the real thing' (RWP/1). For example students preferred to learn on actual equipment rather than from drawings of equipment and they thought that being assessed on real machines or equipment parts is better than 'putting up a drawing and labelling it or worse, getting us to find it in our textbooks and regurgitate' (SOC/9). More important than merely seeing the real thing is that learning is context dependent and takes place through the opportunity to be in and function in the environment (Cussins, 1992). Radiographers have always been trained through a curriculum that includes experiential placement but the students identified an advantage if there was workplace learning not merely work experience. This encouraged academics to persist with the shift from a teaching to a learning focus in order to place the student at the centre of the curriculum.

The ILC created an active learning environment where students participated in a variety of learner centred activities and progressively took responsibility for their own learning and development. Students would learn how to learn rather than be taught what the academics thought they needed to know. The solution to curriculum over-load was therefore, not less information but a focus on learning that equipped students to find information as it became relevant to their professional practice because there is 'failure of remembrance, what we learn in lectures if we don't use it' (QCS/39). Students appreciated the value of having the ability to learn for themselves: 'some subjects should be left to experience and not try make us learn things which either never be used in practice or we can learn later as needed' (SOC/9). The national imperative of life long learning was interpreted as learning how to learn in the ILC. This coincides with the emphasis on learning for knowledge use and production rather than students merely gathering a fixed body of factual knowledge (Everingham, 2003).

Radiography groups have always been relatively small with potential for good student support. The ILC built on this by aiming to simultaneously support the weaker student and advance the strong student. This was done through the promotion of active learning by means of a constructivist approach including activities such as preparatory reading, discussion, process writing and small group learning. The latter offered the greatest gain to both strong and struggling students, which is similar to the finding of (Miflin, 2004). The ILC was also designed to give students the opportunity to practise concepts in multiple contexts in order to reinforce their learning and to facilitate the transfer of the learning.

Portfolios, clinical workbooks and reflections were used to enhance clinical competence, as they required the students to engage as individuals with their personal clinical experience in a conscious and active manner. This is indicative of a student centred learning environment where support was coupled with encouragement for students to take responsibility for their own learning: 'the way things are done now develops confidence in the students and the weaker students also develop and succeed' (FGP2/2); 'there is more mutual support (peer support) between the students and they are less competitive and more helpful to each other' (AG/1); 'this curriculum develops responsible, self-directed learners' (AG/3); 'Learning happens for me, when others have confidence in my capabilities...I need to know that there are people who believe in me. This motivates me to learn' (RWS03/6) and 'creating positivity, support at all time, creating positive attitudes and that someone cares' (RWS03/8). While a student centred environment is important, the motivations for learning can come from many things, even disadvantage: 'of course there are those who've used their culture of non-learning as a catalyst to learn' (FGS1/2).

In a successful student centred learning environment the academics must manage an integrated curriculum to promote active, self-directed learning. They must support students so that they do not feel abandoned and as if they are doing all the work. A student who understands the art of being a teacher reflects: 'on a regular basis, try and get students' involvement as much as possible, without creating an impression of an increased work load' (RWS03/8).

Learning from mistakes

In active, student-centred learning mistakes can contribute to development and learning, as the following student explains:

> '...during my first year up till now I have made various mistakes, theoretically, clinically, practically. For example with my first chest assessment I forgot to set the source image distance. This unfortunately

> resulted into failing my assessment but I have learned a valuable lesson and that is to check my source image distance with every examination whether a chest or whatever (RWS03/4).

The implication that the learning is for professional practice and not merely for the next assessment is encouraging.

The ILC did not always succeed in being student centred. Academics must also learn from mistakes and a student reflection captures much of what inhibits learning:

> Make everyone feel comfortable by not excluding them and by also assuring that whatever answer they give whether right or wrong but their opinion is still very valuable and appreciated towards the topic of discussion. Make them not feel shy about voicing their input. What really does not help is when a lecturer puts a learner on the spot and makes them the subject of the day. It also does not help to take out all your stress on the poor student. The class should be encouraged to stand together as one unit and try to stick together as one family and the lecturer being the parent. This is mostly promoted by the lecturer and how he/she treats each and every single learner in the class. The lecturer should create a friendly and homely environment in which the learners can or are able to adapt with. Each learner should be seen as a unique individual. Lecturers should try by all means not to discriminate learners (FGS2/7).

5.3.3 Assessment

In the subject-based curriculum there was an emphasis on memorizing and regurgitating facts. There was dubious evidence of high-level learning and inconsistent alignment between assessment and the goals of radiography education. Continuous assessment was introduced at the study site a year prior to the introduction of education based on outcomes. The understanding of continuous assessment could be located in two categories: 58% of students who had a basic understanding of continuous assessment as frequent testing throughout the year and the 27% who had a better understanding of continuous assessment enhancing learning (Annexure A2). The ILC built on the strengths of continuous assessment in line with the assessment framework of the higher education institution (Cape Peninsula University of Technology, 2004/5).

The planning team sought to use a wide variety of innovative, meaningful formative, summative and integrated assessments that aligned with the intended professional outcomes. This required integrated assessment tasks, which crossed the boundaries of the subjects. Still some questionable assessment practices remained such as assessment that promotes rote type learning of isolated content. It seems that this happened when the assessment was conducted as a necessary administrative activity detached from the holistic curriculum intention. To avoid this, assessment should be embedded in the curriculum design so that the assessment becomes integral to the way that the learning environment is planned and to the way that learning is enabled.

Some academics thought so strongly about assessment as the key curriculum driver that they motivated carefully planned integrated assessments as the means to engender integrated knowledge acquisition and concluded that in any integrated curriculum there must be integrated assessment. This was extremely difficult for the first group of students who observed the other students being assessed by subject and perceived integrated assessment as far more taxing. Interestingly once this group of students entered level three they spoke positively of integrated assessment. They enjoyed being the expert senior students who motivated the value of the ILC and integrated assessment to the junior groups. Still the students expressed that learning for an integrated assessment is demanding as there is a lot more information and understanding required for each assessment. The skills of rote learning, memorizing and regurgitation that are incubated throughout school life do not work as well and the students are not sure how to replace this study technique with understanding and problem-solving skills essential to integrated assessment.

Formative assessment is valuable in a curriculum for two reasons; it offers additional support to the student who needs this and it develops practitioners who are self-directed learners and who can evaluate their own work and reflect on this in order to adjust and improve their performance. Through formative assessment of professional knowledge the students will also know what to expect in the summative assessments: 'Having some tests formative and seeing the students understanding before a major summative test' (FGS3/13) and 'Formative assessments are helpful as they teach us what is expected in particular assessments and what marks are awarded/deducted for' (RWS03/12).

Optimal assessment should incorporate a range of assessment methods carefully selected to appropriately assess the learning outcomes identified. There must be attention to using the assessment as a learning experience through good feedback: 'When good feedback is provided after tests and assignments, showing you where improvements can be made and how to make those adjustments then I really learn and remember' (RWS03/11). If the ILC is the means of equipping professionals with the kind of knowledge that allows them to work in a modern workplace then the assessment of achievement is likely to best be through a summative integrated assessment in the workplace. Clinical assessment must strive for an objective, reliable and valid means of assessment that is unlikely to be a single assessment tool but rather a multi-method approach by multiple examiners who are carefully selected to assess students in a variety of clinical contexts.

5.4 What was learned about implementing the ILC

The three year phased implementation of the ILC enabled learning. The learning about structural guidelines and the place of the student, academic and practitioner in the curriculum is presented in this section.

5.4.1 Learning about structural guidelines

The most important structural guidelines will be briefly introduced to assist with understanding the structural organization of the ILC.

Year plan (Annexure I)

A year plan indicates weeks (Monday to Friday) that are dedicated to the academy (academic) and weeks allocated to clinical placements (clinical). Learning was planned in the academic and clinical weeks. The traditional block system of extended time in the classroom followed by a long period of work experience was not considered conducive to the integration of knowledge. A day release system had practical difficulties. Hence the ILC used what can be considered as a 'modified block system' or a 'week release system' and it is the latter term that is favoured for the description of this design. The week release system is thought to facilitate effective integrated learning.

The flexibility of the academic weeks was enhanced by moving away from the institutional norm of 45-minute sessions to 30-minute slots up to a maximum of a 2-hour session. This permitted flexibility and the use of a wide variety of the pedagogies. A 30-minute slot is suited to a lecture, short meeting or brief feedback session, a longer session is suited to a workshop or small group activity and activities requiring more than 2 hours can continue after a break. Regrettably this is contrary to the rigid scheduling of the institution that does not encourage innovative teaching and learning activities.

Workplace learning was implemented according to a 40-hour week that is the standard working week for the health service practitioners in this region. The students do the majority of their clinical learning during routine hours (Monday to Friday; 8h00 to 16h30). However, there is a need to expose radiography students to after-hours work experience and all students therefore had the opportunity for weekend, public holiday and night duty experience.

Learner guide and Clinical Work Book

All students received a Learner Guide, to guide classroom-based learning:

> The learner guide is helpful as it gives a bigger picture of what I am working towards – it is good to be able to think in terms of the framework into which a particular topic fits. References on the weekly roster (i.e. to page number in the learner guide) are helpful as we can read about a given topic before the lecture – it helps to have been exposed to the material already, the lecture can then serve to clarify, expand, etc. (RWS03/12).

The Clinical Work Record Book guided learning in the workplace and together with the Learner Guide assisted in achieving the integration of learning from the academy and workplace.

5.4.2 The place of participants in the ILC

The investigation of the ILC through the eyes of students, academics and practitioners highlighted the two most important operational issues as competent educators and the provision of adequate support structures for students. This section provides some understanding for this by presenting the place of participants in the ILC.

The involved student

The ILC offers the interpretation that a student centred learning environment ensures that students really understand their responsibility to learn for themselves and that they find some pleasure in this self-directed learning. Not the pleasure of being happy but the satisfaction of knowing that the challenges and hurdles were successfully negotiated by their own efforts. Therefore, the curriculum should seek more and more to develop students to rely on themselves. While students continued to show a preference for lectures and notes and some even thought of the lecturer in an active learning environment as 'lazy because the students were doing all the work' (QCS/45), there were students who commented positively even when they found it more work. Students also became more positive about self-directed learning in their third year. They grew to appreciate the benefits and felt more comfortable once they had acquired some competencies for self-directed learning and were able to take responsibility for their own success: 'If you are organized...you will always be up to date' (RWS03/10). The most important factor that emerged, as a motivator for student learning was adequate time for students to learn for themselves at their own pace. The greatest inhibitor to learning was a rushed transmission session packed with facts.

The increased use of small groups and self or peer-directed learning made the benefit of relationships noticeable. Students perceived the student body as an important aspect of their success: 'The people you are studying with…if students are dedicated and inspiring to each other learning becomes easier' (RWS03/10) and 'You need to belong to something…a (student) group for example, then you learn better' (RWS03/2).

Students generally appreciated that; 'starting straight from the beginning is a good way of familiarising us to the working world' (RWP/1). However, there are negative aspects: 'as if we are not students, because we are surrounded or enclosed by a working environment' (RWP/1). This is the tension in professional education where integration of the academy and workplace is intense and the pressure on students constant.

Student participation in the development and the ILC was inadequate. While they were able to negotiate changes to curriculum arrangements they were not actively involved in curriculum design. Student opinion and perspectives must be highly valued and understood within the context and there must be continued in-put from students on curriculum because they have much to offer. The relationship between student and academic and student and practitioner is improved with an open environment where the student is heard. However, the outcome is not a happy student but a learning student.

The Competent Academic

Communication skills appear to be the most important skill for the academics in an integrated curriculum where they must be a team working together consistently. The students were at times aware of a lack of communication between the lecturers and this caused confusion, repetition of material or topics and conflicting messages. With the involvement of fewer academics it is easier to achieve cohesion. However, the nature of an integrated curriculum is to involve many rather than few. A benefit of this was that as the ILC progressed academics found connections not previously identified. They developed learning experiences and assessments around the connections (Lake, 2003) to help students understand the connections and achieve integrated learning.

In their new role as facilitators, academics needed to learn how to plan and manage appropriate learning activities. They had to become versed in group work and interactive teaching while being aware of the needs of the individual:

> 'I find group work tedious. I find that when working in a group I concentrate on the part that I have been allocated and don't pay much attention to the rest. I also prefer to work on my own as group work involves others' interpretation of material, which may not necessarily be correct. I think that group presentations can be a waste of time, as it usually takes much longer for a group to present a topic than it would take for a lecturer to do it. It's not that I don't think we should do the research, I just think its tedious having to present it so often and we do lots of presentations' (RWS03/12).

Facilitation of a group does not always mean group work but can also be small group interaction in a different way:

> 'They (lecturers) must be approachable, dedicated, not boring. They must make sure students understand, they must be fair and supportive'

> (RWS03/10). 'A facilitator who is very knowledgeable about the subject and who really understands it is very helpful. Facilitator must also be able to engage our interest so we want to find out' (RWS03/12).

The implementation of a transformed curriculum succeeded because of the enthusiasm and dedicated teamwork of all the academics. Planning was time consuming and needed the commitment of the entire team. In agreement with Brandt (1991), the academics needed to be competent lecturers who were flexible and able to work as a team for an extended period. It is motivation and competence that counts:

> 'Going over to an integrated curriculum was like getting new glasses. I have taught for a long time but have never been so excited about a change. It does not make it easier for me – maybe much more time and effort and I have had to learn new ways of doing things – but I can see that the students are taking more responsibility for their own learning than when I prepared everything and lectured stuff to them. I can also see that everything just makes more sense because me and the students can see why a radiographer has to know this' (A/9).

Participating practitioners

The foundation for effective practitioner participation is the attitude of senior managers to students. If the managers value students in the department this promotes a more generalized positive attitude towards students. Also a high workload and staff shortage can count against the learning benefit of clinical departments because the relationship between student and practitioner is important for learning. Students fared well with the practitioners who have some education knowledge, a natural affinity to students and teaching or who like students and like passing on their professional knowledge.

Formal, planned encounters such as clinical tutorials with practitioners are more easily controlled and evaluated. However, much of the clinical time is not planned beyond the students being assigned to a department or unit. In such cases there may be a specified practitioner supervising the student or the student may be a team member with no specified supervisor. These in-service experiences are essential to integrated learning but real benefit comes only when the practitioner/s in the team view every contact with a student as an opportunity for teaching and learning rather than expecting the student to know without clear instruction or supervision: '...sometimes staff are very hard on you when you produce a radiograph of poor quality because you had not been shown what to do first' (FGS1/4). Learning happens in a supportive environment:

> 'Patient staff who are willing to explain and who have a good theoretical knowledge make it much easier to learn the various procedures' (RWS03/12) and 'When staff within radiography department realize that you are students and don't know everything, you are still learning and therefore don't expect the impossible from you BUT still give you opportunities to learn with their supervision and helpful advice. When staff encourage you to try new things and don't expect a perfect result first time. When staff don't compare you to other students and the level you are at compared to them, what you are able to do and what they are not able to do' (RWS03/11).

Such an environment can be taxing on the practitioners. They need the dedication of a conscientious mentor. Importantly they must be learning themselves as then student learning will be enhanced. The practitioners in this study were not obviously reflective practitioners. Surely there is reflective practice but it is hidden and therefore not obvious to the students. If practitioners are to contribute to the development of reflection in the students this needs to be transparent. A module such as; 'Becoming a Radiographer', presented as a partnership of academics and practitioners could incorporate reflective practice.

5.5 Problems Identified

There were problems that surfaced through the investigation of the ILC. The most important of these are presented here in order to allow fuller understanding of the environment and to high light possible pitfalls to curriculum renewal.

5.5.1 Infrastructure and Administration

The academics chose to move away from the segregation of information into discrete subjects that did not give the students the best chance of immediate knowledge access or opportunity for long-term development in the workplace. However, the radiography programme has a dual system of subjects for registration and funding while stipulated outcomes have to be met and there is an institutional requirement of integrated assessment. This meant the need for the integration of learning areas with largely integrated assessment but students still register for the subjects and assessment results still have to be recorded for the individual subjects. Offering an integrated curriculum with registration and results linked to subjects is an anomaly for which a workable solution had to be found. Students had no difficulty understanding the concept of an assessment contributing to more than one subject: 'Written tests cover more than one subject and this encourages students to think of how each subject fits into the whole picture' (QCS/5). 'Tests and assignments are usually for more than one subject. This is very helpful because it makes students to be able to correlate the subjects they are studying and know their importance in clinical use' (QCS/6). However students generally indicated a preference for assessments of individual subjects. The academic group were not in favour of continuing with subject based teaching and tagging on integrated assessment. But integration was hampered by course administration as students view knowledge as belonging to subjects and there was confusion about the integrated approach when there is retention of subject registration. Registration by subject for an integrated curriculum with integrated assessment is clearly a compromise and not recommended.

This curriculum renewal happened through the driving force of a few enthusiasts with no additional budget for curriculum transformation. Venues limited the changes that could be made to the learning environment to benefit the implementation of an integrated curriculum. For example facilities for information resourcing are inadequate to encourage students to seek knowledge, there is no skills laboratory and the space for small group tutorials and student group work is inadequate. Sustainability is in question as without recognition of the value of an integrated approach there may be restructuring and budgeting that forces a return to a more manageable curriculum design. Long-term success will depend on support from institutional management that includes financial support for continued curriculum development.

5.5.2 Time and Skills

Curriculum transformation and the development of an integrated curriculum demands time and skills. The ILC approach was not an easy option and there were at times inadequate time and skills to allow thoughtful development. This meant that there was some unstructured and unplanned meaningless integration. It was difficult to find the common planning time needed to select learning topics, explore resources, discuss student learning styles and student needs, as well as to co-ordinate teaching schedules and prepare and mark integrated assessments. Academics needed to develop expertise for integrated teaching and learning and assessment, which again meant time. Lack of time and skills are a reason not to consider an integrated curriculum. Possibly it was due to the matter of time and skills that there was a shift away from optimism for extreme integration to a more moderate ILC approach.

5.5.3 The Challenge of Change

Change is not easy. There was some fear for letting go of the 'old' syllabus content and subject structure. The changes made had to be such that the team could cope with the amount of change but the change also had to be meaningful for those wanting change to feel satisfied with it. The eclectic approach of the ILC allowed meaningful change to suit the context but it is a curriculum that cannot profess to be a fully integrated curriculum design. At times the academics revert to giving lectures the way they used to. To change was difficult and to sustain the changes even harder. The hope is that incremental change that ratchets curriculum development forward is a suitable curriculum approach to a changing environment.

Commonality

The overlap of information in the four radiography categories is described as, common. When the information was truly common, the students enjoyed the interaction of the big group. They disliked being together when the learning was not relevant to them and overall preferred being in category specific groups where the learning was focussed. Thus, one intention of the ILC was to move away from the forced commonality of the subject-based curriculum while strengthening the benefits of a multi-professional environment because the institution offers all four categories of radiography. The ILC design had less common to all categories than previously and the intention was to have a flexible learning environment to accommodate students from all or some of the categories being together when the learning area being covered was considered relevant to them. Hence a common Learner Guide: '...students from all (categories)...will learn together', with sub-sections as per the specific differences and needs of the four categories.

In reality the flexible learning approach did not work. There was slippage and the structure with regard to commonality reverted to being very like the previous curriculum. Year one is essentially common; year two has common theory and year three as entirely category specific. This in part reflects the shared outcomes of the radiography categories but the main reason is that the increased workload required for flexible, multi-disciplinary learning was not sustainable. There is still not optimum category specific learning or effective utilization of multi-disciplinary learning opportunities at all levels. So while the ILC is different in pedagogy, assessment and intention, the familiarity of structured commonality was in the end easier than the complexities of a more flexible approach.

5.5.4 Over-load

Work over-load was probably the most serious and frequent criticism of the subject-based curriculum and students complained that much of the theory was unnecessary to their future as a radiographer. The ILC did not successfully remove the perception of work overload for the students as demonstrated by 40% of students alluding to the academic load more than once during the study: 'The amount of homework we get, can cause a lot of stress and anxiety' (FGS2/2). The criticism was particularly marked where the academic knowledge was perceived as irrelevant. This academic stress was worsened by stress in the workplace: 'a department overflowing with patients...not time to rest or take a break...you are so exhausted' (RWS03/1). Possibly the very nature of professional education that integrates learning in the academy and workplace will stress and tire students. They carry a dual responsibility and have to maintain a constant level of involvement and contribution without the space that full-time academic students enjoy. The load of the radiography curriculum continues to be an issue and we need to seek ways to ease the pressure in order to make space to allow the full benefit of self-directed learning and knowledge exploration because: 'learning happens when sufficient time is allocated to complete the learning tasks properly' (RWS03/11). The ILC is not there yet.

5.6 Conclusion

Some learning about radiographic knowledge and the implications of integration on the curriculum will be presented as a conclusion to the case study.

5.6.1 Radiographic Knowledge

The key components of radiographic knowledge as they surfaced in this study are presented as a summary on learning about radiographic knowledge.

Competence in the use of complex equipment

In the rapidly developing high-technology environment of radiography the need for technology competence was identified as the ability to select and apply a technology appropriate to the given situation: '...within the clinical department you learn how to choose the right devices and to handle complicated equipment...' (FGS1/3). Technology competence is also the ability to identify technological problems and even solve some of these: '...in trauma, the simplest examination (procedure) can result in a difficult examination (because the patient is seriously injured) so the technology must be good and used differently' (FGS1/1). Technology is familiar to the student of today and they notice when the technology is below what they consider up-to-date: 'Try most of the time to use more recent technology to get everyone involved' (FGS2/6).

Communication skills

The learning environment must entrench communication as a norm: 'When there is a good communication system between lecturers and learners, this allows for everyone to have a good knowledge of what is expected of you' (RWS03/11) and 'Easy communication, able to say what's bothering you' (RWS03/8). The ILC focused on professional communication, such as communication competencies in English and the language of radiography, sensitivity to a multi-lingual environment and scientific writing. This has developed to where academics are engaging with the idea of oral communication competency in regional languages other than English. This will help to overcome the hurdle of unwillingness to even participate in another language and mean that students are more likely to communicate in all the regional languages (Wyrley-Birch, 2004) to the benefit of patient care and professional satisfaction: 'What I like about learning radiography is that it teaches you...communication skills...in the clinical department you learn to somehow understand your patients. You learn how to deal with difficult patients, disabled patients and also normal patients. But not speaking their language is difficult' (FGS3/15).

Being a multidisciplinary team member

Skills must be acquired for participation in a multi-professional team. This comes from working in a team: 'When everyone within the learning area works well together and when you feel comfortable to approach anyone when you need help' (FGS1/1) and 'I would encourage more group work too as this certainly built camaraderie amongst us. Dealing with conflict is but one issue that...arised and this surely teaches us interpersonal skills. Knowing how to speak to someone appropriately' (RWP/1).

The view that it is preferable to achieve one's own professionalism and then learn to work in a health care team was countered by the need to develop the student by contact with other health care practitioners from early on in the programme. In the ILC planned learning opportunities such as multi-professional student groups, varied workplace opportunities and a multi-professional curriculum team facilitated this. The importance of the latter emerged as an aspiration to acquire a new, negotiated way of working in which academics, students and practitioners collaboratively plan and monitor student learning and take joint responsibility for radiography education. A true multi-professional, collaborative education programme is wanted.

Empathy

In South Africa the essential need of empathy for the patient: ' ...we could put ourselves in the patients shoes so as to also feel their emotion, trauma and fears. We are now able to not only see the patient...but see the patient as a person...We are able to treat each patient as an individual' (RWP/1) must be extended to the need for cultural sensitivity: 'Physical factors such as where home is, how big home is, how many people you live with, is there electricity...' (RWS03/10).

Ability to find information

Access to information: '... a well stocked library is one of the most useful things' (RWS03/12); '... equipped with libraries, study halls, computer lab and people trained to offer help and advise' (RWS03/11), is the beginning. However, students did not appear to see their responsibility in the appropriate analysis, interpretation or utilization of the information they found which is likely to be a serious gap in the development of information literacy. Computer literacy (word processing, spread sheets, e-mail, databases) from information literacy (performing bibliographic retrieval, accessing and evaluating online information) are particularly important abilities which students need to develop when engaging in resource-based learning (Elfrink, Gorman & Rathe, 2001). The students' ability to retrieve, evaluate and use information needs further investigation.

Care for self, others and the environment

Radiographers have to develop responsibility towards themselves, others and the environment with regard to ionising radiation. In addition there are important general safety issues in the workplace such as the safe disposal of all hospital waste. Students recognized that as members of the health care team they have a responsibility to the health and safety of others: '...it (radiography) teaches you how to care for your fellow man' (RWS03/1). The most frequently mentioned issue of safety was minimizing the risk of needle-stick injuries. Awareness did not include broader environmental issues.

Problem-solving

Debate around problem-solving being a generic competency or a highly contextualised skill guided the academics to favour the opinion that students could learn 'to problem-solve'. The opinion was that with some guidance and practise this skill could be transferred to future unknown contexts. Hence the systems approach of the ILC contained problem-solving activities to guide the understanding of complex relationships within demarcated limits that offered the student opportunities for experiential problem-solving in order to acquire the generic competency: '...practicing as one (radiographer) is a day to day learning process...every patient's body and problem is different' (RWS03/2) and 'from learning to analyse the problems and look at the possible solutions you would more learn how to deal with situations' (RWS03/8).

Professionalism and work ethic

The busy clinical schedule and practitioners who are not consistent, positive role models: 'In the department we work under pressure and learn to think quickly and just do things. We do learn wrong things from the staff and other students. It is hard to unlearn these bad practices but at least the lecturers try to show us the ideal' (FGS3/10), means that responsibility lies with the academy to ensure the integration of issues such as professionalism and ethics from the outset.

5.6.3 Implications for the curriculum

This section presents the implications to the curriculum of the learning that surfaced in this study of the ILC.

Learning strategies

Learning strategies were considered in different ways: 'It is important for us to make good notes - to be able to make good notes we must understand the topic, then later when we study the notes just remind us' (RWS03/12); 'If staff who have a good theoretical knowledge are willing to be patient and explain it is much easier to learn' (FGS1/5) and 'Feedback is one of the most useful things, especially when we have done a particular type of assignment for the first time' (RWS03/12).

What needs to be balanced is that with too much scaffolding the students tended to rely on the structure rather than on themselves as independent learners. They were then active, directed learners rather than active, self-directed learners. The ILC was adequate in creating a learning environment with structure and planned opportunities to enhance integration but did not always build in adequate time and space for optimal self-directed learning and self-exploration.

Learning areas as the organizer

In the first year students must acquire a vast amount of foundational knowledge in health science disciplines and a 'learning area approach' was considered as suitable to facilitate the integration of learning guided by the Exit Level Outcomes. This was largely common for all categories and can be considered as the core curriculum or basic principles of radiography. The loss of academic subjects, as the organizing structure, was not unanimously favoured for first year and will no doubt be reviewed again in the future.

A systems approach

A systems approach was found to be effective as a thematic organizer for the second year. This was described as: 'A way that divides the body of learning into digestible portions or containable bits. All the subject knowledge of anatomy, physiology, pathology and imaging modalities were integrated with the relevant science principles taught in parallel and cross referenced' (AG/7). A system has resonance across most of the knowledge areas and facilitates the acquisition of integrated knowledge relevant to the modern radiography workplace. This acted against the tendency to reductionism by an approach that considers the context of a problem before breaking it down into more manageable parts. However, there was not always cohesion between the required knowledge and a systems approach is a highly theoretical and traditional organizing system that does not necessarily encourage interdisciplinary teaching. Organizing themes such as, People and Society that are presented at the University of Sydney (2004) offer a less traditional and more holistic view of the health sciences (Everingham, 2003). Such learning areas could be considered for radiography but were not a component of the ILC as it was first implemented.

The third year, specific to each category, was also a systems approach in the main but with the most variations in design and implementation. All the academics involved at this level continued to strive towards a learning environment that enabled the acquisition of integrated knowledge and integrated assessment remained a priority. However, at this exit level for the radiography diploma, the policy of the higher education institution had to be adhered to. This level was, therefore, conducted within the framework of satisfying external moderators for each subject. Some moderators grasped the potential gains of an integrated curriculum such that they adjusted to integrated assessment with enthusiasm. Others wanted the retention of at least some subject specific assessment at the level where integration makes the most sense.

From vocation to emerging profession

World wide the historic development of radiography training was through an in-service training model of qualified radiographers passing on their 'trade'. The vocational, hospital based teaching model perpetuated 'practice-directed' training of highly skilled technologists. In South Africa responsibility for the education of radiographers was transferred to higher education during the 1980s - 1990s. Similar transitions were happening in many parts of the world as radiography moved to degree offering status.

Looking back, the strength of radiography training being hospital based for so long was ultimately a weakness. Radiographers were not equipped with an education enabling them to take responsibility or initiative for the development of the knowledge base of radiography. It is since the transition to higher education institutions that there has been an intense period of development of radiography into a profession with a shared repertoire of ideas, accumulating professionally specialized knowledge and advancing professional practice (Lave & Wenger, 1991). But the danger of the 'academisation' of radiography is that as the reference curriculum shifts from being directed by the workplace to being directed by changes in higher education, the swing can be too far away from the workplace. A balance is needed so that the two facets of workplace and higher education are held in close proximity, drawing on both for curriculum development. The tensions between the demands of a modern workplace, the drive for professional development and a curriculum needing disciplinary and practice knowledge must be constructively managed to allow the radiography profession to fully emerge.

Understanding professional education

Not unexpectedly 18/ 25 (72%) of the students entering the radiography programme in 2001 wanted to learn about the career. Their understanding of what radiography involved was limited but reasonable. They focused on patient care: 'responsible for the well-being of patients' (BLS/6) and the technological aspects of being a radiographer in one of the categories: 'taking x-rays to locate any abnormalities' (BLS/3), 'use radioactive material to examine the inside of the body' (BLS/5), 'use radiation to treat disease' (BLS/8) and 'scans to check irregularities in a person and to check the size and health of the baby' (BLS/11). In contrast the students' understanding about learning was generally poor as shown by 7/26 (27%) who had some understanding of professional education as the need for integrated workplace and academy learning: 'working in a hospital as well as attending classes' (BLS/24), 'a work-study course' (BLS/5) and 'complete a certain amount of clinical time while you study' (BLS/11).

The purpose of radiography education is the development of professional radiographic knowledge (theoretical knowledge, clinical competence and generic competencies) needed for independent practice in the profession. Considering how someone might learn this professional knowledge; 22/23 (96%) students indicated a preference for experiencing something themselves in order to know how to do it: 'I find it better to do things for myself. In that way its little bit easy to know my strong and weak points I have and how to work on them' (BLS/23). There were 11/23 (48%) that qualified this preference with the proviso that: 'you need to know it first as no one can live without first being told by someone how to do things.' (BLS/9). There was 1 student who indicated an opinion that it is possible to learn in theory how to do something in practice and who does not consider experience important for learning a practical skill.

This student opinion supports the existence of a curriculum integrating learning in the workplace and academy, the basis of the ILC. This involves student radiographers leaving secondary school and entering radiography where they simultaneously become higher education students and trainee practitioners through clinical placement that ensures authentic workplace opportunities. The need for teaching and learning disciplinary knowledge related to radiography continues but this does not require learning to conform to the disciplinary silos of the traditional subject-based syllabus. The aim of the ILC was to integrate vertical academic knowledge (Bernstein, 1999), shared by the specialist community of radiography, and horizontal knowledge (Bernstein, 1999) acquired through practice. The latter is additional, flexible and changeable and can be likened to knowledge gained through 'situated learning' by engaging in a 'community of practice' (Lave & Wenger, 1991) for the acculturation of the new professional. In radiography the value of our horizontal, situated knowledge has tended to be taken for granted but as the profession develops this is being recognized as valuable professional knowledge. The ILC was planned recognising that while there may be a theoretical distinction in the two types of knowledge, neither one is superior or inferior to the other nor does either have a more important purpose. Neither horizontal nor vertical knowledge are exclusively found in the workplace or in formal teaching sites but rather both knowledge forms can be found in both sites although with differences in how they are built and transferred within and beyond their origins. Integration in the ILC is managed through transaction spaces that influence the articulation between the academic and workplace curriculum to promote integrated professional knowledge. This aims to develop newly qualified radiographers who have knowledge and competencies of immediate usefulness, value and relevance to the workplace of a service profession for the benefit of the patient, public and society.

6. An integrated learning curriculum in radiography

> ...the idea of 'learning how to learn' looks to a parsimonious approach to curriculum design. Far from packing a curriculum with pure knowledge, knowledge as such might even be jettisoned and, instead, time and effort can be used in imaginative ways of stimulating students' capacities for learning for and by themselves...Pushed to its limit, the learning how to learn idea could be said to herald the redundancy of knowledge as such as a component of curricula (Barnett & Coate, 2005: 42).

Drawing on the findings of the national survey (chapter 4) and the case study (chapter 5), this chapter presents a framework for an ILC in radiography. The framework presents curriculum renewal as a process, considers the roles played by academic radiographers, offers an understanding of the culture of the clinical environment and, describes a variety of models of integration, as well as criteria for the design and evaluation of a curriculum intending integration.

6.1 Curriculum renewal as a process

To enable the successful implementation of a revised curriculum there are a number of questions to ask, which could be thought of as the; 'What? Why? Who? When? Where? and How?' of curriculum. These questions include: What concepts and content should the curriculum facilitate? Why should particular topics be more extensively covered than others? When should these topics be introduced, what is an appropriate sequence? Who should facilitate the curriculum and how should they achieve this (that is, what pedagogies should they use)? Where should learning take place? How should learning be facilitated? In the next section I outline an eight-step process; a way of systematically addressing these questions. The steps are not directional or in a strict order. They can take place simultaneously and can be revisited. But it is necessary to address these steps when embarking on curriculum change.

6.1.1 Decision to change existing practice

Deciding to change existing practice in favour of curriculum change to a new but as yet unspecified design can result from curriculum evaluation. This is an essential step in the continuous curriculum cycle or from a context of transformation and change, as was the case in the case study described in chapter 5. In the case of South African higher education, transformation and contextual change are also policy-driven (Mungazi & Walker, 1997). Thus, policy is also a powerful driver towards curriculum reform. In the case study, an evaluation of existing practice, mapped against national education and health policy, drove the process of curriculum renewal. Any of the curriculum stakeholders; higher education policy makers and/or academics, the workplace practitioners or the students, can propose changes to an existing curriculum, but responsibility will tend to rest with the academics. If change is to happen they will need to be persuaded to acknowledge that curriculum change is needed and that educational practices must be re-conceptualised. This decision sets the process of curriculum renewal in motion.

6.1.2 Exploration of options and context

Wide exploration of as many curriculum options as possible is needed in order to understand the choices available. Every curriculum is context dependant (Barnett & Coate, 2005). The context therefore needs to be understood, for it will enable or constrain particular curricular options. The collaborative effort of curriculum investigation will involve academics in a process of meta-analysis as they draw on their collective experience and knowledge of alternative curriculum options and debate the contextual implications as part of their contribution to the suggested alternatives for possible change. The process should include open discussion of individuals' ideas, perceptions and understandings, as well as the research-based advantages and disadvantages of implementing such changes. Considering the suitability of any curriculum innovations for the specific context is the beginning of the next step; adapt and design.

6.1.3 Adapt and Design

Curriculum renewal is unlikely to involve the wholesale adoption of a curriculum from another site. Only very rarely can a curriculum be directly transferred from one context to another, without some adaptation to accommodate the variations and peculiarities of the environment where it will be implemented (Adamson & Mahony 2001). An integrated curriculum will, by definition, involve a team of role players, and while there will not necessarily be absolute agreement on the detail of curricular activities, there must be broad agreement on the most appropriate action for curriculum renewal. In other words, the design is arrived at by consensus. The details of the design structure and essential criteria that are developed in the collaborative process will be discussed more fully in sections 6.5 – 6.9 of this chapter.

6.1.4 Negotiation for change

Professional programmes that integrate learning for the development of professional knowledge require a partnership between the academy and the workplace. In curriculum renewal, ideas and intentions need to be negotiated and motivated if the implementation of the curriculum is to have any chance of success. This requires that there is involvement through partnerships from early on in the process. It is essential to negotiate when curriculum change is intended, but ideally negotiation will continue throughout implementation of a revised curriculum and beyond to achieve a continuously negotiated curriculum.

6.1.5 Planning the integrated curriculum

Planning of the curriculum detail is guided by the broad principles determined in advance. Planning for the collaborative, mutually supportive development of the ILC was guided by the broad principle of an eclectic, integrated curriculum. Further guiding principles were that information from subjects would be integrated through topics, there would be the integration of generic competencies into professional learning, student participation would be enhanced to promote self-directed learning, the majority of assessments would be integrated, and group planning would take place. In the planning stage these guiding principles must be translated into a carefully structured and detailed curriculum plan that can be interpreted for implementation as intended. Planning is not an isolated event. It involves reflection on practice, the revisiting of curriculum options and adaptations, and will require continued negotiation if the implementation of the revised curriculum is to be successful.

6.1.6 Implementation

It can be argued that the entire curriculum should be planned before commencing with implementation. However, this is seldom possible as it would require a break in offering the programme in order to free the academic team for the time needed to plan three or four years ahead (Adamson & Mahony, 2001). An alternative, phased-in approach was used for the curriculum of the case study. The broad goals of the entire design were known in advance, but the detailed planning was merely a step ahead of implementation. While such a phased-in approach does not offer the opportunity to view the entire curriculum plan, the advantage is that learning from continuous review benefited later phases of implementation.

6.1.7 Continuous reflection and evaluation

The curriculum process must include structured review and curriculum evaluation through feedback from students, academics and practitioners (employers/supervisors). The focus of the evaluation should be to ascertain whether the intentions of the curriculum renewal have been achieved, whether these are still appropriate, and what adjustments should be made to the curriculum. The burden of continuous reflection and evaluation can be onerous for participants, but particularly for the student group. To overcome this in the case study, the pioneer cohort of students were encouraged to see themselves as 'trailblazers' rather than 'guinea pigs'. They understood that recording their experience of the curriculum would help to guide and re-shape changes to the curriculum. The process of educational innovation has many benefits for 'trailblazers', particularly in terms of an increased level of intellectual excitement, the promotion of reflective learning, and the fostering of mentoring relationships between lecturers and students (Breslow, 2000). Norman, Van der Vleuten & Newble (2002) provide evidence-based studies in medical and health science education to explain the benefits of innovation for both the trailblazers and subsequent students. In agreement with these authors the case study findings showed that, in addition to formal, intended evaluation activities, the informal evaluation events and participant reflections were valuable for fostering relationships, promoting learning, and monitoring the curriculum in progress. This is also congruent with concepts of professionals in a modern workplace as reflective practitioners (Bebb & Pittam, 2004). Through innovation and reflection, a continuous cycle of review and evaluation, with academics leading the process, replaces programme evaluation at the end of an offering, or on an annual basis. Learning is thus continuously incorporated into the re-design of a curriculum.

6.1.8 Consolidation and Adjustment

There is likely to be partial consolidation of at least the broad intentions and design rather than immediate radical change, if the curriculum renewal was systematically processed. However, curriculum review will inevitably lead to further adjustment and change, in the dynamic process of curriculum renewal (Bebb & Pittam, 2004). Adjustments will involve all the steps of the curriculum process but they will be more focussed. This means that as the curriculum process progresses the steps are repeated but within the broad principles of the implemented curriculum until such time as there is major change that requires a new cycle of curriculum renewal.

The process of curriculum renewal, described above, is summarised as a diagrammatic representation, in Figure 6.1.

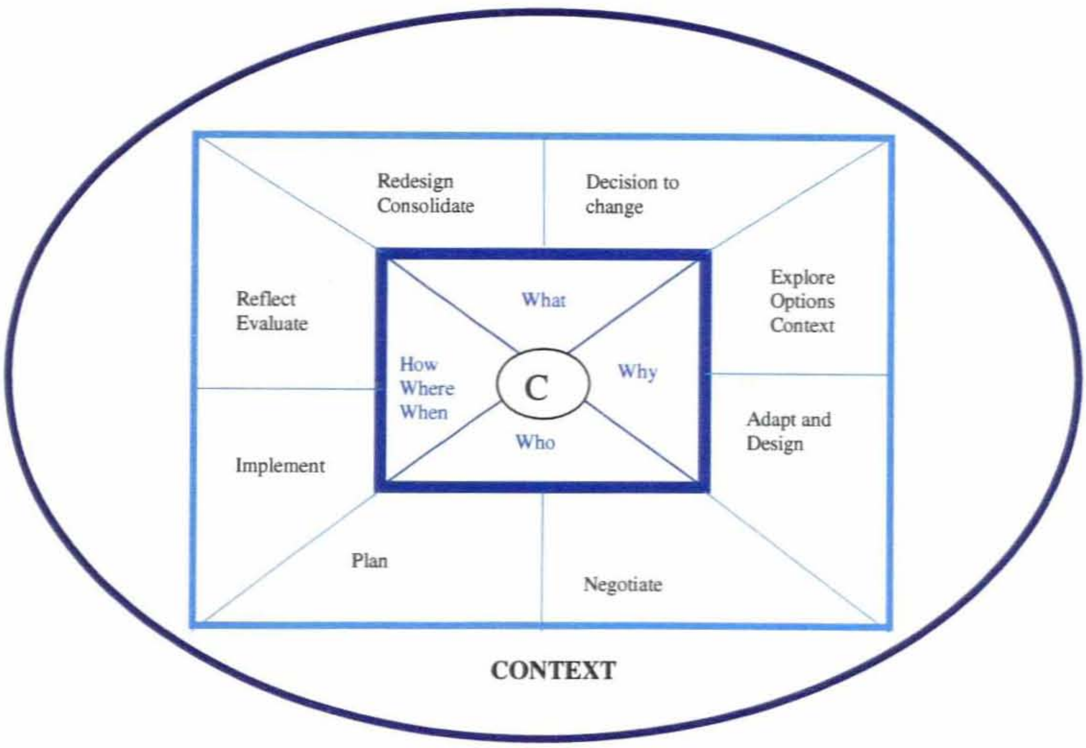

Figure 6.1: Representation of curriculum renewal as a process

6.2 Academic roles and the Integrated Curriculum (Who)

Roles that are essential for curriculum renewal emerged in the findings of both the national survey and the case study. These are likely to exist in a somewhat revised format in any curriculum renewal process. The roles, assumed by participants in the ILC, were not pre-determined, nor did they belong to individuals. Rather individuals took on roles as a need arose. This meant that there was flexibility and movement between roles. Often more than one person took on a particular role and most individuals in the team occupied two or more roles simultaneously.

6.2.1 The curriculum design team

The curriculum process for successful implementation of the ILC required an integrated team of dedicated academics. Throughout the process there were regular meetings of this united 'Curriculum Design Team' to collaborate on the overall design and the guiding principles for each level. The leadership function shifted depending on the particular discussion or level being planned. In addition individuals, or ad hoc small-groups, worked on tasks, such as planning learning activities, scheduling workplace opportunities or preparing integrated assessment. Such activities were identified and delegated by the 'Programme Leader' or 'Level Leader'. The ILC utilized all the academic members in a flexible structure of migrating leadership. In the team of nine academics no one escaped taking a leadership role for at least some part of the curriculum renewal process. This, therefore, required a dynamic curriculum design team such that each member of the team fulfilled a function according to the current need rather than predetermined, structural roles.

6.2.2 Academic leader

As academic leader at the site of the case study I was accountable for the curriculum renewal process[4]. This included taking on the role of developing a long-term vision for the radiography programme and ensuring sustained momentum by motivating all the academics to be innovative and seek solutions to the many problems that arose. A person should take the role of academic leader with enthusiasm for curriculum, insight into the profession and authority to make decisions and change the way things are done. The academic leader must be a member of the curriculum design team. But it is the curriculum design team and programme/level leaders who make curriculum decisions with the support of the academic leader.

6.2.3 Programme leader (Category leader)

Different academics took on the responsibility for a category, or programme, in its entirety. As key role-players, these academics had the responsibility of documenting and co-ordinating the revision at each level. Programme leaders

[4] In many higher education institutions radiography is a department with a head of department who carries the functions of academic leader and administrative manager. At CPUT radiography is a 'sub-section' of a department including other health science programmes. The heavily loaded head of department takes on the role of administrative manager at institutional level while a senior lecturer fulfills the other head of department functions at programme level.

needed good professional knowledge in the discipline and in higher education, as well as a broad knowledge of health care in general. Programme leaders must have an established network and respect in the workplace in order to promote uptake of the curriculum renewal intention and process, and to maintain good collaborative working environments. Programme leaders must have authority at programme level.

6.2.4 Level leader

Level leaders were responsible for a level within a programme or category. This academic had to facilitate the collaborative process and manage a multi-professional environment for a curriculum level. Skills in the administration and documentation of a revised curriculum were needed, as well as the ability to motivate the team to keep on track with curriculum implementation. Level leaders must have authority to take responsibility for teaching, learning and assessment. This includes facilitating the design of learning units, the delivery of learning experiences and student assessment in a planned, team approach. They must be able to manage change in the way things are done locally for a level of a category of radiography.

6.2.5 Teaching and learning leader

Teaching and learning leaders implemented the revised curriculum as innovative learning opportunities. A single leader can manage the learning environment, as was commonly the case with the ILC. Alternatively there can be team teaching with one leader co-ordinating the activity, which occurred for some learning areas of the ILC. This reflective practitioner must conduct classroom-based research and reflection for continuous curriculum evaluation, must interpret the findings and be competent to motivate and argue for amendments and further change. If curriculum renewal is going to succeed this person must be able to resist the tendency to slip back to doing things the old way.

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In the changing environment of higher education people at all levels are increasingly being called upon to be leaders (Bergmann, Hurson & Russ-Eft, 1999). These leaders desire transformation but they work within a team and as the team members face the challenge of change they learn together. The notion of migrating leadership that emerged in this study is supported by the concept of distributed leadership that Knight & Trowler (2001) present as suited to the higher education context of the present. They suggest that the focus is much less on the leader as an individual but rather it is the team effort that is the key to success. Quality higher education depends on the quality of its human resources. This translates into the need for senior leaders to lead others to become leaders themselves. This is either through the dispersal of power or through liberating team members to fully utilize their individual abilities (Kouzes & Posner, 1995). Such leadership on the ground suits the context of radiography in South Africa today.

6.3 The Culture of the Clinical Environment (Where)

The integration of effective workplace learning through appropriate opportunities for learning within a caring environment of good role models, effective supervision, guidance, feedback and facilitation is essential. Not all work experience is effective and this is partly attributable to the tension that exists between the need to train students and the inconvenience of having students in the workplace. Then there are employers who do not understand how to provide an effective workplace-learning environment and also those who have no interest in the learning needs of the student/employee. The impact of students on workplace productivity must not be under-estimated and in particular novice workers require time-consuming supervision and teaching (Cornford, 2000). Good supervision was shown to be particularly difficult to sustain in workplaces where the staff numbers have been cut and concern for productivity is paramount.

Understanding of this complex network of interacting systems is essential to curriculum. I use the activities and interdependencies within the workplace

(Billet, 1999) in order to describe the culture of the workplace. These are adjusted to apply to the clinical sites where student radiographers acquire clinical competence.

6.3.1 Activities in radiography practice

In the discussion below I present the adjusted categories of workplace activities to aid understanding of the workplace as a complex environment that student radiographers must enter and acclimatize to. The discussion briefly indicates how the integrated curriculum can accommodate the environment and prepare students for entry into and success in the workplace.

Routine

While routine exists in radiography practice, the micro-context of even the most basic procedure is different because each patient is unique. The more complex the investigation, the more opportunity there is for variation. Where non-routine is highest there is the greatest requirement for robust knowledge and the ability to transfer learning in an ever-changing workplace. An integrated curriculum can schedule the acquisition of clinical competence from more to less routine and equip the student to transfer relevant professional knowledge for practice in a non-routine environment.

Autonomy

The scope of radiography practice offers variations in autonomy that involves the need for greater or lesser independence including independent problem-solving and decision-making. Autonomy requires a reflective practitioner who can learn from their own practice and a practitioner who knows when to ask for help, who to ask, and what to ask. Autonomy is first gained on routine procedures and subsequently for more complex, non-routine practice. An integrated curriculum allows student radiographers to develop from the need for intensive supervision to minimal or indirect supervision. As newly qualified practitioners, radiographers must act independently with immediate effect in routine professional practice and rapidly develop as independent practitioners in non-routine situations.

Intensity

Intensity is the degree to which work pressure demands strategies for managing the workload and multi-tasking. As full-time students with dual responsibility, student radiographers have to learn to manage the very taxing and stressful load of being in the academy and workplace. Still, dealing with intensity did not come easily to all students and as newly qualified radiographers they could not all manage the workload of a clinical department with insight. The integrated curriculum can help to prepare practitioners for the reality of intense practice that demands a professional who is able to balance a multitude of tasks and responsibilities. It helps to overcome the harsh criticism by experienced practitioners when newly qualified radiographers cannot respond appropriately to intensity within the department.

Heterogeneity

The range of activities can be described by the concept of heterogeneity. The practitioner in radiography must be able to conduct a wide range of procedures on a wide range of patients utilizing a wide range of equipment and this is, therefore, heterogeneous practice. A student cannot be taught each and every procedure within every situation, but the integrated curriculum can develop a practitioner who is able to practice in a heterogeneous environment by transferring knowledge and through reflective practice.

Complexity

The degree to which there are variables in the radiographic task and the requirement for negotiation among these variables determines the complexity. As with routine and heterogeneity this can vary for given environments and circumstances. Complexity arises from the need for individualized patient care in a high technology world and the curriculum must enable the radiographer to practice in this complex environment.

Accessibility

There is the need for unique radiographic knowledge, other disciplinary knowledge and workplace competence. This professional knowledge required in the workplace can be more or less accessible. The less accessible or hidden knowledge is made more accessible if practitioners have a good disciplinary foundation and generic competencies that permit them to engage in life long learning. As reflective practitioners who develop in the profession and adjust to the environmental changes they break through the boundaries of inaccessible knowledge. A curriculum can therefore free radiographers to demystify knowledge and create new knowledge or trap them in the limitations of what knowledge is accessible to them.

6.3.2 Interdependencies in radiography practice

In the discussion below I present categories of workplace interdependencies adjusted for the radiography workplace. There is brief discussion on how the integrated curriculum can contribute to preparing students for this complex environment.

Interpersonal interactions

As members of the multi-disciplinary health care team the practice of radiographers is premised on teamwork and interactions with others. While radiographers often work autonomously they never work in isolation as they inevitably interact with patients, the public and other members of the team. Education and training must develop interpersonal and team skills and a participatory integrated curriculum has the potential to achieve this better than a traditional curriculum.

Engagement

I interpret engagement as being part of and actively participating in the environment. A radiography curriculum depends on engagement in two environments; the academy and the workplace. The basis of engagement in the workplace is a learning focus with a curriculum of engagement through knowing, acting and being (Barnett & Coate, 2005). This is preparation for the changing nature of the engagement as the student progressess through the levels of the programme, becomes a qualified radiographer in community service and then an independent practitioner in the state or private sector.

Status of radiography

The status or standing of radiography varies according to influences such as the education level of radiographers, the structure of the health service and the community in which a radiographer operates. At the meso level this aspect, more than any other, is defined by the context and can vary between institutions and even between departments within an institution. At the macro level there is global transition with the professionalization of radiography. In a transforming South Africa radiography is striving to develop an identity and acknowledgement of professional status. Curriculum can impact on the status of the profession and radiography curricula in this country need to take note of the message they convey.

Access to participation

Access to participation is interpreted as both the range of radiographic activities that students are able to participate in and the factors in the environment that enable or inhibit their ability to actively participate. Ideally the environment should be such that full participation is encouraged and ensured. The curriculum design should promote access to participation in a wide range of increasingly complex tasks. This relies on involved practitioners who are concerned about the development of practitioners for the future. They must facilitate practice learning through being affirming mentors who offer access to a range of activities.

Reciprocity of values

The student practitioner must be introduced to the professional world of shared values amongst radiographers as important members of the health care team. The integrated curriculum promotes awareness through contact with practitioners. This can be a positive influence by radiographers who promote the values and ethics of their profession. However it was also found that there could be negative influence from practitioners who do not value their profession. A curriculum that enables reflection and openness can assist the student to evaluate the different messages and make a choice on what shared values they will inculcate.

6.4 The nature of curricular integration (How, What)

An integrated curriculum can involve the integration of varied aspects. The identification of what is to be integrated is an important decision in developing any integrated curriculum. In the case of the ILC there was more than the integration of theory and practice. There was integration of subjects, disciplines, language, professional competency, generic competencies, values and attitudes.

6.4.1 Subjects/ Disciplines

The ILC endeavoured to fuse subject/discipline boundaries by integrating the information from all the subjects/disciplines of a particular level through the thematic approach of learning areas or systems. Subjects/disciplines can disappear entirely when integration is through some other organizing structure such as problems or scenarios. This can be limited to the integrated learning of information belonging to specific professional practice or can be extended to interdisciplinary courses or multidisciplinary groups.

6.4.2 Clinical practice

Health science programmes are structured for the integration of clinical practice in varying degrees. There can be loose integration of experience through experiential learning from short visits or planned and sequenced integration of the workplace learning through sustained integration of learning opportunities involving the academy and workplace (Mbali, 2004). The ILC aimed to enhance the integration of learning in the academy and workplace through more concerted connections, structured sequencing and a focus on learning rather than experience in the workplace.

6.4.3 Language

The ILC was a curriculum with intentional integration of language skills, such as scientific writing, effective medical communication and oral competence. These skills were not learnt separately but were integrated into the professional learning opportunities. Language integration more easily involves the language of instruction, as was the case in the ILC. However, there can be further integration through optimal utilization of a multi-lingual environment. An example of this is the gaining of workplace competence in one or more languages other than the dominant language of higher education. This helps to break the hurdle of unwillingness to participate in another language and will enhance learning and professional practice that benefits the health service for all people in a multi-lingual country (Wyrley-Birch, 2004).

6.4.4 Generic competencies

Professional development must prepare the practitioner for the workplace. An integrated curriculum can facilitate a learning environment that promotes the holistic acquisition of integrated professional and generic competencies and achieve this goal. The generic competency of language was so important in the ILC that it was discussed separately. Other important generic competencies such as working in a multi-professional team, caring, cultural sensitivity, problem-solving, ethical decision-making and many others can also be integrated. In the ILC the nature of integration was such that generic competencies were integrated rather than having the learning of generic competencies and professional knowledge separated.

6.5 Continuum of integration: how much integration is appropriate?

An integrated curriculum is not a description of a single curriculum type. Rather it describes a family of curricula that integrate different elements (Figure 6.3) to differing amounts (Figure 6.2). The amount of integration in a curriculum can be represented by a continuum from absent to extensive (Figure 6.2). The intention of the ILC was integration. However, learning activities varied in the degree of integration. At times the information of a single subject was presented with minimal or no integration (absent integration) and at times there was the integration of all theory, practice and generic competencies (extensive integration).

Absent	*Conservative*	*Moderate*	*Considerable*	*Extensive*

——————— *INTEGRATION* ———————→

Figure 6.2: Continuum of Integration in the Curriculum

The ILC aimed to integrate all curriculum elements through learning areas or systems. This meant the nature of the integration was the integration of subjects/disciplines, clinical practice, language and other generic competencies. On the continuum presented in Figure 6.3 the ILC could probably be considered as the integration of most curriculum elements.

None	*Two*	*Several*	*Multiple*	*Most*

——————— *INTEGRATED CURRICULUM ELEMENTS* ———————→

Figure 6.3: Continuum of Curriculum Elements Integrated

Student participation was found to be a key curriculum change. As the degree of participation could vary considerably depending on the particular learning activity, the academic or practitioner presenting the activity and the students involved, it is useful to also plot student participation on a continuum (Figure 6.4). This helps to further describe an integrated curriculum or a particular event within an integrated curriculum. The ILC showed the full range of student participation from students being passive recipients of information to being active learners. However, the intention was to considerably increase the level of student participation and create an active learning environment.

Passive	*Conservative*	*Moderate*	*Considerable*	*Active*

STUDENT PARTICIPATION →

Figure 6.4: Continuum of Student Participation in an Integrated Curriculum

Overall the ILC can be considered to be a curriculum with moderate to considerable integration of most curriculum elements and involving a considerable amount of student involvement.

6.6 Typology of an Integrated Curriculum (How)

During this study I explored one integrated curriculum in depth and found that the ILC does not fit a single type on the theoretical typologies of Fogarty (1991) and Harden (2000). Rather I was able to identify a range of integration of varied elements within this one curriculum. It also became evident that the degree of student participation impacts on the degree of integration of a curriculum activity. However, the ILC can broadly be considered as a multi- and trans-disciplinary integrated curriculum with immersion of the learner (Fogarty, 1991; Harden, 2000); see Table 2.1. It falls into the 'integrated-type' of Bernstein (1975) as although some subject-based teaching was retained, or crept back in, the strict segregation of knowledge according to subjects was removed. In terms of the four approaches of Khan (1995); see Table 2.2, the ILC can be considered as having full engagement as the practitioners and profession play a key role in identifying the learning areas for radiography programmes.

A typology of integrations uncovered in this study is presented as contributory to the useful models of Fogarty (1991) and Harden (2000). This can be used as a Typology if the type of curriculum is determined by its most dominant features. However, the typology does not imply that any curriculum can necessarily be confined to a single type and category combinations will inevitably exist.

6.6.1 Absent integration

This is a curriculum void of planned integration such as the traditional subject-based, transmission mode approach. Absent integration involves the presentation of the same information to a group of students and generally leads to the acquisition of similar information by all students. The extreme version of an entire curriculum absent of any integration is unlikely to exist. More likely there will be some level of integration. A subject-based curriculum can in fact be delivered anywhere along the continuum from no planned integration or the integration of theory and practice as the responsibility of the student to integration of some content of some subjects and could even be extensive integration through a thematic integration of all subjects.

6.6.2 Phased integration

A tension exists, in the academic team, between those who consider the formal teaching of core elements of relevant disciplines as a necessary foundation to integration and those that motivate for integration from the outset. The former defend the importance of a structured disciplinary approach for grounding in the discipline/s before integration. They argue that this foundation allows the student to build on the concepts and knowledge in a useful way such that later integration of knowledge is facilitated. This approach can be considered as phased integration with an absence of integration initially followed by integrated teaching and learning.

6.6.3 Passive integration

When the lecturer sources the information and delivers a lecture, integrating the information for the students, it can be considered as a curriculum with passive integration. In this situation the lecturer frequently prepares notes, to integrate the learning areas from multiple sources. Learning in this environment does not involve the student referring to original sources but rather involves memorizing information from notes in a digested format. There is integration, however the student is the passive recipient of integrated material.

6.6.4 Active integration

If it is accepted that active participation in the learning environment will enhance the learning of concepts, content and skills then the learning environment should be designed for student involvement. In the ILC it was evident that in situations where the students were active participants, the chance of integration was high because students naturally crossed boundaries to explore issues of interest and relevance to them. Such a participatory, student-centred curriculum is active integration for active learning.

6.6.5 Supported integration

Lectures may be included even in the most extensive forms of integrated curricula. They were found to be useful where learning areas are not comprehensively covered in any text and where the verbal explanation of an expert lecturer facilitates learning. Where this happens frequently it can give rise to a curriculum type that can be described as supported integration. Discipline specific lectures or provided resources are implanted to support learning in an integrated curriculum.

6.6.6 Thematic Approach

A thematic approach is the use of themes as the organizing structure for integrating knowledge in the curriculum. A theme is more than something that loosely connects a series of activities. It is an agent that facilitates student learning and understanding through enhancing the linking of conceptual connections. Examples of themes found in the ILC were learning areas, for example radiation protection, professionalism, HIV/Aids in the workplace and systems. The latter were ultimately recognised as a curriculum type distinct from the thematic approach.

6.6.7 Systems Approach

The systems approach to integrating knowledge is the presentation of a curriculum with systems as the organizing structure. These systems can be the systems of the body (respiratory system) or a less rigid explanation of the systems approach might be any unifying 'system' where the knowledge is selected according to its relevance to that 'system'. Some levels of the ILC used systems, defined as a part of the body with specific imaging or treatment requirements (thorax), to integrate theoretical knowledge with clinical practice. The systems approach is therefore appropriate for developing professional knowledge in radiography where relevant radiographic knowledge can be consolidated through systems as defined by practice.

6.6.8 Parallel Integration

Here two or more lecturers prepared learning activities delivered as separate 'subjects' but in parallel classes with the same focussing topic or theme. Themes should not be selected for convenience with arbitrary connections but should arise out of meaningful connections that cut across the content areas of subjects. In parts of the ILC subjects were retained within the systems thematic approach. At times the information was presented making relevant connections between subjects. This is an example of what I call parallel integration.

6.6.9 Modular Integration

In this curriculum type modules are identified that can stand independently within a curriculum that ultimately seeks to integrate knowledge. Each module is presented with an integrated learning approach. To enhance the integrated modular curriculum connections can be made between modules and integrated assessment can assess across modules. The ILC has examples of stand-alone integrated modules (intra-modular integration) and modules presented with connections between modules (inter-modular integration) in the programme that has modules. Themes can be seen as modules and again there can be intra- and inter-modular/theme integration.

6.6.10 Extensive integration

Extensive integration goes beyond the blurring of subjects to offering the information in such a way that the knowledge is so co-dependent that boundaries disappear. In this curriculum the transfer of learning occurs seamlessly as no learning is bound to a subject or discipline. The differentiation between theoretical knowledge and clinical competence is ill defined as all learning is directed towards the development of professional practice. PBL is an example of extensive integration. Another example is Community Based Education (CBE) that has community issues/problems as the stimulant for learning and where much of the learning takes place through involvement in the actual community context. Service Learning, if used as the organizing structure of the curriculum, would be similar to CBE.

Elements of PBL and CBE can be incorporated into any of the integration types such as the use of PBL incorporated into a systems approach. Problem oriented learning using case scenarios was used in the ILC to connect the information from all subjects to the clinical reality. This facilitated students gaining a more complete and contextual understanding of their role as a radiographer.

6.7 Structure of an integrated curriculum (How & When)

The traditional radiography curriculum involves workplace experience underpinned by relevant theory. The goal of many integrated curricula, including the ILC, is the active integration of these two components. The curriculum types presented above describe levels of integration identified through this study. These typologies can describe a programme, a level or even a learning activity. An explanation of the structure of integration across the entire programme can also be a useful tool in describing the integrated curriculum.

The metaphor of the modern workplace needing T-shaped people (European Science Foundation, 2002), to T-shaped research centres, where the down stroke is excellence and the cross stroke relevance in strategic research (Rip, 2003a & 2004), can be further extended. The form of the T-shape that contributes to the description of the integrated curriculum is that of the down stroke being traditional disciplinary knowledge and the cross stroke experience based knowledge (Rip, 2005) although the author considers the existence of a productive tension at the interface rather than integration.

Radiography may be described by starting from the cross-stroke (Figure 6.5) as the traditional knowledge environment of radiographic practice. The traditional disciplines (physics, anatomy, psychology and others) that underpin radiography practice are presented by multiple down strokes. The up-stroke indicates the development of the profession as a non-traditional or applied discipline engaging in relevant knowledge production. This model helps to describe the holistic development of the radiography student. An integrated curriculum can enhance this development by engagement in activities that connect the academic and practice worlds to encourage knowledge production and benefit the emerging applied profession. The radiographer practitioner becomes 'T-shaped' with the opportunity for life long learning in a developing profession.

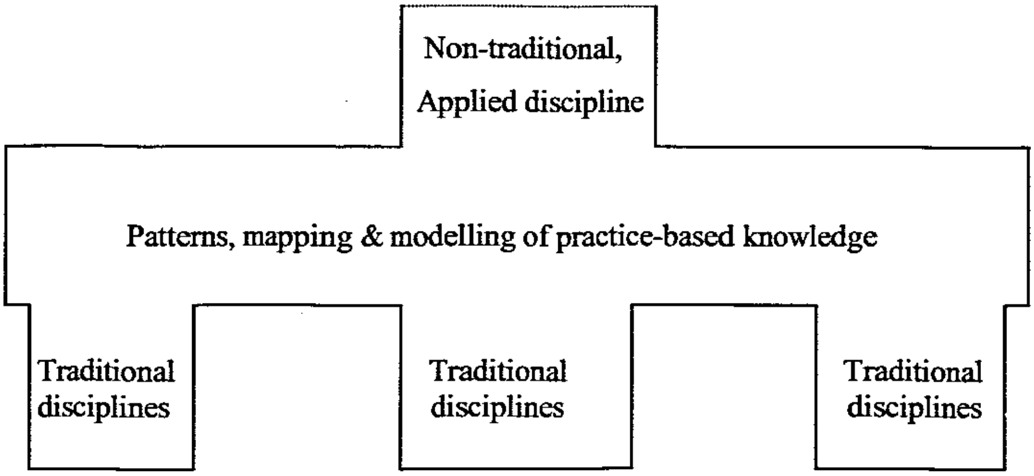

Figure 6.5: Curriculum for T-shaped practitioners

The features of vertical, horizontal and spiral integration have been used to describe the integration of the down and cross stroke of the 'T' for integrated curricula in health sciences. Vertical integration is described as a bridge between the pre-clinical and clinical divide by teaching the content concurrently such that integration of learning areas occurs throughout the programme but with discipline boundaries remaining in tact (Ker, 2001; Reser, 2000). Horizontal integration is a more integrated curriculum that lessens the interruption between basic and clinical sciences by integrating across learning areas or subjects/disciplines (Ker, 2001; Reser, 2000). The Spiral curriculum is still further integrated with a structure for an iterative process in relation to subjects (Reser, 2000). The curriculum types presented in 6.6 can all have elements of horizontal, vertical and/or spiral integration but the more integrated the curriculum, the more likely there is to be horizontal or spiral integration. This study identified variations and extensions to these descriptions of integration that are considered useful in order to expand the understanding of integrated curricula. The options represent complete programmes.

6.7.1 Continuous Vertical Integration

Continuous vertical integration suits an environment where, although integration can take place throughout the programme, the bulk of the theory component is learnt early on in the course with steadily more integration as clinical practice is introduced.

Vertical Wedge approach

In the approach I call a vertical wedge approach (Figure 6.6), the emphasis is on increasing clinical sciences from year one until practice dominates the curriculum when the student is ready to qualify and enter full-time professional practice. There is an early focus on information in-put. The applied and clinical sciences increase during the programme, although both are present throughout the programme. The decreasing basic sciences information may increase in complexity and is delivered through classroom-based teaching as a foundation for workplace experience. The vertical wedge approach can have little integration that depends on students applying the basic science information to the clinical experience or there can be an intentional emphasis on active integration.

The traditional radiography programme is an example of this approach in-so-far as there is decreasing theory and increasing clinical practice. However, the focus of classroom information in radiography tends to be applied theory with relatively little basic science information. The traditional radiography programme tends to involve passive integration in the classroom and workplace integration that is largely the responsibility of the student.

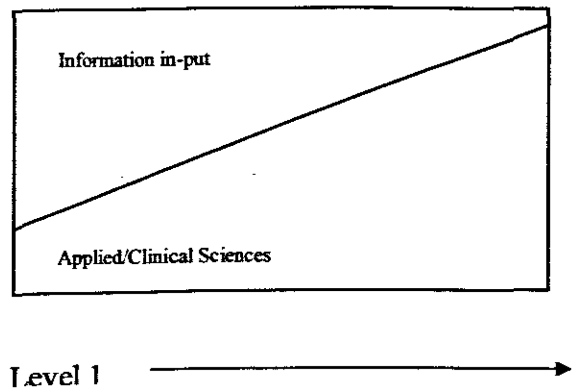

Figure 6.6: Wedge approach to Vertical integration

6.7.2 Continuous Horizontal Integration

Continuous horizontal integration in the health sciences achieves the integration of theory learning areas (horizontal integration) with the inclusion of professional practice, from early on and across all levels of the programme. The student engages with theory and practice in an integrated way with minimal learning outside of an integrated format. This can be, for example, horizontal integration through the systems approach. Figure 6.7 shows horizontal integration for one system. Continuous horizontal integration allows for sustained acquisition of deepening vertical knowledge and simultaneous acquisition of horizontal knowledge from workplace learning. The tendency is for the integration of theory into clinical practice. However, clinical practice integrated into the theory is also advantageous to learning and does happen when the academics maintain currency in workplace competence. This structure describes the design of the ILC although it went beyond the relationship between theoretical information and clinical competence and included the integration of generic competencies. For example there was horizontal presentation of communication theory and the transfer of these as workplace competencies.

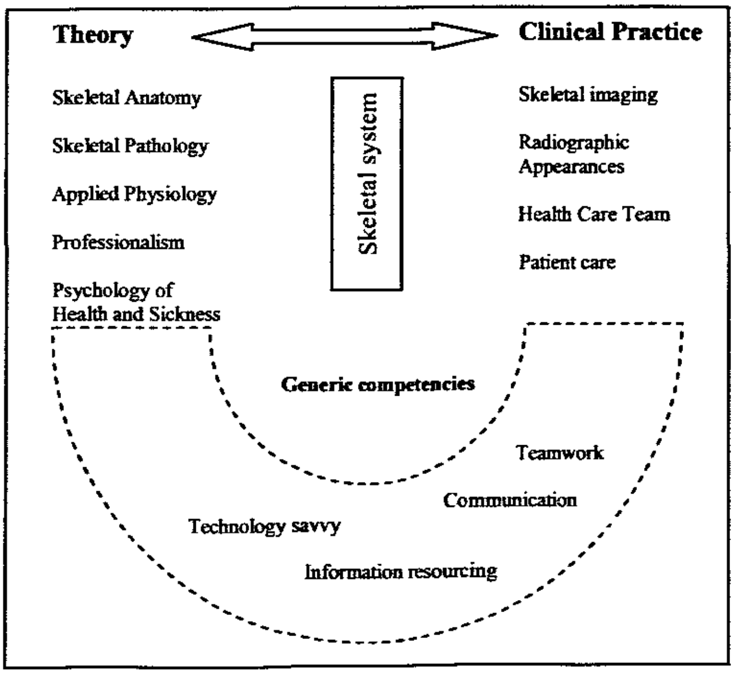

Figure 6.7: Horizontal integration for the skeletal system

6.7.3 Scattered integration

In this curriculum structure the integration of the disciplines/subjects or components appear scattered throughout the programme. The phenomenon of scattered integration was found when the integration was not planned for but was the result of individually motivated integration such that each lecturer implemented integration in their own way to develop the learning environment to meet intended outcomes. The scattered integration occurrences can be converted to learning in a systematic and relevant way if planning takes place for the sequencing of problems, learning topics or outcomes towards the building of knowledge and concepts. Scattered integration was evident in the transition phase when academics were testing innovative teaching and learning methods before the ILC was implemented.

6.7.4 Spiral integration

The structure of spiral integration as described in the SPICES model from Dundee (Harden, Snowden & Dunn, 1984) achieves integration that spirals through the learning events. In the ILC there was evidence of the basic and human sciences spiralling into the clinical sciences and vice versa. The spiral structure allowed for some learning topics to be revisited with an increasing depth of vertical knowledge gained each time. With spiral integration in the health sciences there tends to be less integration early on in the course when the basic sciences are taught. There is steadily more integration as the clinical sciences and clinical practice are introduced. As the ILC introduced the integration of theory and practice from early on in the course it is more appropriately described as continuous horizontal integration with elements of vertical and spiral integration.

It is through understanding the variations and combinations of integration that health science educators will select the type and structure of integrated curriculum that will suit the particular circumstances of their environment.

6.8 Components of the ILC (What & How)

Another aspect of the framework that is useful for designing an integrated curriculum builds on the essential components of a successful integrated curriculum proposed by Shoemaker (1989). These are presented below.

6.8.1 Curriculum themes

The academic team identified learning areas such as radiation protection and body systems that were selected for the appropriate connections they made to the national outcomes and the theoretical content known to be necessary for the development of professional knowledge in radiography. These predetermined broad curriculum themes were the organizing structure of the ILC that allowed the detail of the learning areas to unfold in a dynamic way as the curriculum detail was planned and implemented.

6.8.2 Unit development

Curriculum themes evolved into detailed learning areas that could be divided into smaller units, manageable as individual learning activities. Where necessary a focused, stand-alone activity was included to cover a learning outcome or information not accommodated by the curriculum themes.

6.8.3 Generic competencies

Generic competencies, such as scientific writing, problem-solving, cultural awareness and professionalism were integrated into the professional knowledge component of the ILC. Support structures such as computer tutorials were implemented for the development of these competencies. Even with the integration of generic competencies they remained identifiable as a unique component and it was in rare circumstances that they were indistinguishable from professional learning. Hence they continue to be mentioned as a separate entity though with the intention of integrating them into professional knowledge and assessing them through integrated assessment.

6.8.4 Assessment

The ILC was designed as a pedagogical approach for structuring learning rather than being implemented as an assessment method. However since the aim of radiography education is based on performance as a practitioner, the need for rigorous and reliable competency assessment was acknowledged. The ILC did not therefore aim to replace previously tested assessment methods that were considered compatible with integrated knowledge acquisition. Assessment such as the Objective Structured Clinical Examination (OSCE) was therefore retained while integrated assessment such as Portfolio assessment was implemented. In determining suitable assessment practices it was useful to distinguish between the methods, sources and instruments of assessment (Brualdi, 1998). 'Method' refers to the approach that is used to assess learning such as essays, multiple choice questions, case report, portfolio and so on. 'Source' refers to the person who will do the assessment, such as the lecturer, clinical practitioner, and student or peer group. 'Instrument' refers to the criteria and marking scales. With the aim of the ILC being to develop integrated professional knowledge students needed to be assessed in an integrated format and there was an attempt to develop an assessment strategy in line with the design that was:

- ***Holistic*** as there is integrated assessment of attitudes, values, skills and knowledge;
- ***Fair*** because of the use of a variety of assessment methods;
- ***Inclusive*** since there is assessment of all theory and practice;
- ***Transparent*** due to the availability of assessment criteria (Oliver, 1998);
- ***Success oriented*** due to inclusion of formative and summative continuous assessment (AAG/3).

6.8.5 Integrated Evaluation

Continuous integrated evaluation of the ILC was conducted through formal evaluation processes such as student's quarterly reports and programme evaluations and informal activities such as verbal feedback and reflective writing.

Continuous evaluation of the what, how, feasibility, education value and assessment value of the ILC contributed to establishing the way forward in the curriculum process. Preparation of performance indicators (Everingham, 2003) to monitor and evaluate a curriculum in a structured way is recommended but was not done for the ILC. There has also not yet been research to investigate the impact of curriculum renewal at this site.

6.9 Criteria for an integrated curriculum (Why)

A Council on Higher Education document covers Criteria for Institutional Audits that offers guidance on the review and evaluation of programmes in South Africa (Council on Higher Education, 2004). This can be made more specific to an integrated curriculum through the consideration of what enabled and constrained effective implementation of the ILC at the strategic and operational level. The enablers can be considered as criteria for an integrated curriculum. Criteria for a common curriculum platform in health sciences, intended to assist with the design of a curriculum and that could later be used for the evaluation of the curriculum (Everingham, 2003) correspond closely to criteria identified in this research. The essential elements reported by Lake (2003) for an integrated or interdisciplinary curriculum are; 1) a design that combines the subjects or learning areas with a thematic organizing principle, 2) a plan to demonstrate the relationships between concepts and topics, 3) a flexible schedule, 4) the use of small group learning, 5) the use of information resources beyond a textbook, and 6) an emphasis on projects and integrated assessment. These are also consistent with the criteria identified for the ILC.

In the lists that follow the criteria identified in this study will be integrated with published criteria (Everingham, 2003; Dunaway & Faingold, 2001; Senge *et al.*, 1999; Lipson *et al.*, 1993; MacIver, 1990; Wissenschaftsforum Bildung und Gesellschaft, 1998; McLean, 2004; Moust, Van Berkel & Schmidt, 2004; Lake, 2003) to establish criteria for the design and evaluation of integrated curricula in the health sciences and possibly other professional education programmes.

6.9.1 External Alignment

External alignments are considered to be the alignments that are beyond the boundaries of the immediate environment of the curriculum. Attention to such alignment helps to ensure that the educational activities equip the student for life outside of the university. Those that emerged as important for the ILC can be summarised as follows:

- Alignment with national higher education and health policy.
- Alignment with the minimum professional requirements.
- Alignment (in terms of functional cooperation) between the academy and the workplace/s.
- Alignment with the teaching and learning strategy of the institution.
- Alignment with the assessment strategy and policy of the institution.
- Alignment in terms of curricular adaptation for the specific needs of the context.

6.9.2 Internal Alignment

In the ILC the internal alignments are considered to be those alignments that exist within the boundaries of the curriculum. Alignment is not a single dimension and can be the alignment of multiple perspectives. The internal alignments that emerged as important can be summarized as:

- Alignment between the programme outcomes and the curriculum design.
- Alignment between the curriculum design and the plan of individual learning activities.
- Alignment within the curriculum to promote connections and the transfer of learning.
- Alignment between assessment practices, the outcomes, the curriculum design and the learning activities.
- Harmony between the knowledge/content and the process of the curriculum.

- Incorporation of multiple perspectives to develop an integrated knowledge base.

6.9.3 Common understanding (Team work)

There is the need for some level of common understanding between group members. This helps to guide and direct the curriculum process in a consistent manner and helps to avoid confusion through mixed messages because of different understandings. The actions that were found to improve the development of a common understanding in the ILC process are listed below.

- Academic team that is motivated to collaborate.
- A supportive management structure in place.
- Negotiation for agreement on the understanding of terms such as theme, formative assessment. The establishment of consistent terminology by all participants reduces confusion.
- Consensus on what will be integrated, for example subjects, clinical competencies, concepts and generic competencies.
- Consensus on the structure of the integrated curriculum and the plan of individual learning activities.
- Regular team sessions for planning, sharing knowledge.
- Negotiation of common goals and ideals of examiners and moderators.
- Team planning of all assessments but particularly of any integrated assessments.
- Team planning of curriculum evaluation and discussion of any evaluations or reviews conducted.
- Student involvement in the entire curriculum process.
- Documented information presented to students in advance about the curriculum intention, why this approach is used and how it will positively affect their learning and growth as professionals.

6.9.4 Relevance

It was important that the ILC had relevance to professional radiographic practice and was appropriate and relevant to the needs of the context within which it was implemented. In order to enhance such relevance, the following are recommended:

- Academics to stay in close contact with the radiography profession through being involved in the professional association and retaining currency in radiographic practice.
- Evidence of inter/multi-disciplinary learning in the curriculum.
- Students to gain early contact with practice and establish a professional identity.
- Integration of academy and workplace learning from the outset rather than delaying workplace opportunities.
- Appropriate assessment as an integral part of learning, including integrated assessment.
- Assessment that requires evidence of the application and transfer of knowledge in clinical practice.
- Assessment that promotes good learning habits and rewards professional behaviour.
- Knowledge currency within the curriculum to take account of global, national, regional and local needs.
- An integrated knowledge base that facilitates the fast retrieval of information.
- The integrated acquisition of generic competencies.
- Development of reflective practitioners with skills for life long learning.

6.9.5 Scheduling and Flexibility

An integrated curriculum needs careful scheduling and structuring to promote relevant integrated learning. However, the study of the ILC also showed that rigidity can be stifling and that some flexibility was a benefit as this permitted individuality and innovation. Maintaining the balance between a coherent curriculum structure that allowed some flexibility is helped by:

- The existence of an appropriate long-term curriculum vision.
- A documented curriculum design for the entire programme.
- Documented planning of medium and short-term intentions.
- Team planning for the scope and sequence of concepts, knowledge and learning activities that facilitates the structured acquisition and integration of the student's professional knowledge base.
- Multiple opportunities for students to practice learning in different contexts.
- Assessment schedule published well in advance.
- Publication of broad assessment criteria given to the student in advance.
- Curriculum activities incorporating a variety of teaching and learning experiences appropriate to integrated and self-directed learning.
- Curriculum activities to accommodate different learning styles.
- Varied assessment methods to accommodate different learning styles.
- A schedule that prevents serious over load and facilitates full participation by students, practitioners and academics.
- Space and time in the schedule for students to engage in exploration and reflection.

6.9.6 Efficiency

Efficiency in the curriculum and the effective utilization of resources is enhanced through:

- Planning for teaching and learning efficiency.
- Realistic face-to-face contact hours.
- Developing the student through formative assessments.
- Avoiding onerous assessments that duplicate what is being assessed.

- Inclusion of integrated assessment.
- Appropriate and optimal use of information resources for self-directed learning.
- Available support services that are effectively incorporated and utilized.
- Opportunity for the development of personal competence by all participants.
- Promotion of positive attitudes in students and academics.

6.9.7 Institutional support for sustaining the ILC

To sustain a curriculum there needs to be an institutional infrastructure that supports the continued offering of the curriculum. For example the ILC was supported to a limited extent by educational strategies within the institution but did not enjoy appropriate administrative support. The long-term sustainability of the ILC will be influenced by the following infrastructural considerations:

- Changes to administrative structures, policies and procedures to accommodate and promote an integrated curriculum.
- Containable increase in expenditure.
- A shared vision by all stakeholders.
- Building of an institutional teaching and learning community to overcome the lonely journey of isolated academics implementing an innovative curriculum.
- Reward for commitment to curriculum development and research, as it is the efforts of the dedicated few that sustain continuous curriculum innovation

6.9.8 Curriculum infrastructure to sustain the ILC

The structure and dynamic of the curriculum itself also contributes to sustaining a curriculum. The long-term sustainability of the ILC will be influenced by the following curriculum considerations:

- Take small, incremental steps to change curriculum practice and avoid slipping back to past practice if it is not considered to be 'good practice'.
- Continued and improved collaboration between students, academics and practitioners about the curriculum.
- Management of team planning to avoid inefficiency, maximise participation and ensure shared responsibility.
- Respect for disciplines by being as inclusive as possible of all disciplines.
- Innovative teaching and learning methods that promote integrated learning.
- Enhancing the active learning environment to further develop self-directed learners.
- Variety in the learning environment to foster and sustain student, practitioner and academic motivation.
- Elimination of duplication and redundancy of information presented.
- Planning for curriculum evaluation to takes account of burden to the participants.
- Regular communication of progress on the curriculum process to sustain enthusiasm and deal with any variations that arise.
- Gradual transfer of control over thinking and learning processes to the student to enable self-directed learning, independent practice and life long learning.

The typology, structure and criteria can be used together as a framework. This framework can operate as a guideline for setting strategic objectives and for the conceptualisation, effective planning and implementation of an integrated curriculum. The framework can also be used as a standard for the evaluation of an integrated curriculum. There is potential for this framework to be applied to curricula for the refinement of the learning environment in order to facilitate learning for professional practice.

6.10 Limitations of the study

The research had two main data sources: a national survey and a case study of an ILC. In this section, I reflect briefly on some of the limitations of the data and the findings for wider application.

6.10.1 National survey

There are eight radiography education departments located in universities in different parts of South Africa. The questionnaire was posted to all these departments. Five departments responded to the request to distribute the questionnaire. The system of distribution of the questionnaires did not specify the number of academic, practitioner, and student respondents. I did not verify the questionnaire findings with the participating institutions, as the intention of the survey was to identify broad trends, rather than detailed, accurate information. The covering letter of the questionnaire did not specifically explain the nature of the research project to the participants, as it was not felt to be necessary at the time. In retrospect, I should have indicated the number of academic, practitioner and student respondents for each institution, done a 'member check' (Babbie & Mouton, 2002) with the participating institutions, and given more explicit information in the covering letter. These actions could have made the findings of this research project more widely transferable to other radiography education programmes in South Africa.

Further to this it is recommended that any future use of the survey instrument should include testing for reliability and validity.

6.10.2 Case study

The focus of the case study was 'curriculum' in the sense of the sequencing, pacing, presentation, and facilitation of radiographic knowledge. I did not focus on the academic or clinical assessment of radiographic knowledge. I acknowledge that assessment sources, methods, and instruments of assessment will need to be key issues in follow-up studies in order to enable those of us involved in the ILC to evaluate the effectiveness of curricular development.

6.11 The questions answered

In order to sum up the main findings from this research I return to the questions posed in the first chapter:

1) What is the nature of radiographic knowledge?
2) What curricular options would facilitate radiographic knowledge?
3) What would enable or constrain successful curriculum implementation?
4) Is the ILC an appropriate curriculum for Radiography?

6.11.1 What is the nature of radiographic knowledge?

The underpinning of a curriculum is knowledge. Radiography, as a profession, has a body of specialised knowledge acquired through involvement in a community of practice (Lave and Wenger, 1991) and necessary for entry into the radiography community. This knowledge includes the content, problem-solving, epistemic and inquiry knowledge identified by Perkins (1992). Billett (2000) proposes a way to understand the relationship between thinking, acting and learning that makes up knowing in the workplace. For effective learning there need to be appropriate opportunities for learning within a caring environment of good role models, effective supervision, guidance with feedback and facilitation.
Research on generic competencies concludes that workplaces enhance learning through having 'breadth as well as depth' (Holland and Leggett, 2000). The most important generic competencies that emerged from this research are self-directed learning, problem-solving and critical thinking. I suggest that reflective practice together with critical and lateral thinking lead to *critical clinical reasoning*, the competence for critical reasoning to enhance clinical practice. This competency allows the practitioner to continuously analyse and assess the clinical environment with a critical reasoning approach.

Thus radiographic knowledge can be described as the disciplinary, professional and clinical knowledge that supports radiographic practice. Radiographic knowledge has elements of the 'verticality' and 'horizontality' that Bernstein (1999) suggests as a way to understand knowledge. It is consistent with the concept of the transdisciplinary 'supertechnologist' (Friedenberg, 2000) that emerged from rethinking the knowledge base of radiography. It is also consistent with the 'T-shaped' model for professional knowledge (Rip, 2003a) that indicates the need for depth of disciplinary knowledge and transcontextual collaboration.

If the curriculum aim is achievement of expected competencies for radiography practice then it is professional/clinical knowledge that is highly relevant. The three areas of clinical knowledge identified in this research where; clinical ability (the ability to consider options, make decisions about practice in context, and perform radiographic tasks appropriately), clinical understanding (an understanding of relevant theory linked to the radiographic task and insight about the 'what' and 'why' of radiographic practice) and reflective clinical practice (ability to link understanding to performance, to learn from practice, to adapt to change and the unforeseen, and to pass reasoned judgement on different ways to perform the task).

6.11.2 What curricular options would facilitate radiographic knowledge?

In the fast changing workplace of radiography that involves; an expanding body of knowledge; technological development; the need for multi-professional cooperation; the recognition of the importance of primary health care; well informed patients who require a shared decision making process; the promotion of best evidence medicine; health promotion and disease prevention as a priority; a diverse student body; changes in society and state demands for higher education such as the compulsory inclusion of generic competencies; and the negative impact of separating disciplines in a world that needs practitioners to be able to solve interdisciplinary problems (Dent, 2001; Aitken *et al.*, 2001; Jacob, 1989;

Benjamin, 1989), the existing links between a higher education programme and its related workplace may no longer be adequate.

Radiographers gain their identity from clinical practice in radiation medicine. Thee development of competence in clinical and academic contexts is facilitated by range of educational practices, variously known as 'multidisciplinary', 'interdisciplinary', 'transdisciplinary', 'multi-professional', and 'inter-professional' (Graham & Wealthall, 1999; Pirrie, Hamilton, & Wilson, 1999). Lipson's (1993) work supports the use of an integrated curriculum because it helps students apply skills, provides an integrated knowledge base that leads to faster retrieval of information, encourages depth and breadth in learning, promotes positive attitudes in students, provides for more quality time for curriculum explorations, and uses multiple perspectives that lead to a more integrated knowledge base.

The shift to an ILC was identified as necessary in order to move away from the transmission of skills and information to the creation of learning experiences in the classroom and in the clinical environment that would enhance the acquisition of integrated and structured knowledge with direct clinical relevance. Learning was put at the heart of the change to facilitate the students' professional development by providing a knowledge base for rational problem-solving that allows good clinical reasoning (Dunaway & Faingold, 2001). A curriculum that is learning-focused will help in the struggle to keep up with the rapid pace of technology development in radiography. By putting *learning* at the centre of the curriculum, and building independent and life long learners, radiographers will be prepared for uncertainty and change.

6.11.3 What would enable or constrain successful curriculum implementation?

There is guidance from literature on factors that contribute to successful curriculum implementation however Robins, White & Fantone (2000) consider the real challenge in curriculum reform is sustaining the change. This challenge was also a component in this research. Some of the original ideas underlying the curriculum renewal, such as the importance of student participation, were eroded to some extent during implementation. Things such as inadequate student-staff ratios and the difficulty of changing well-rehearsed teaching styles can explain this. Another fact that interfered with implementing the ILC as planned was the fear of some academics that subject content would not be adequately covered through this curriculum innovation. This led to practices such as reverting to the lecture mode and giving directed reading lists such that most students studied the same resources. This lead to retention of a content-driven curriculum and for some the role of the lecturer gradually reverted from that of a facilitator who motivates and guides student learning to simply that of a conveyer of information. The message of that curriculum reform is not a single event, but must be continuously renewed (Robins, Whit & Fantone, 2000) must be heard. In a continuous cycle of curriculum innovation and renewal the educators will more easily resist slipping back to the practices of the past.

The ILC is an eclectic approach that promotes integration and enhances a learning focus. An eclectic approach contributed to successful implementation as the strengths of curricula types and the strengths of each member could be applied to the curriculum renewal. However and integrated curriculum was encouraged and facilitated without those involved necessarily understanding explicitly about curricular integration, or identifying the 'ideal' Radiography curriculum as an integrated curriculum, or without fully understanding the implications of transformation to such an integrated curriculum. Such academic development in advance would certainly contribute to successful implementation of a revised curriculum.

Development and implementation of the ILC depended on a committed team, their interpretation of the context of change being called for in higher education, and their translation of the needs of the modern workplace. The lonely journey was travelled by a dedicated team of radiography educators, without the direct support of institutional infrastructure or guidance. The investment of energy and effort to change individual practice and sustain enthusiasm for curriculum renewal is enhanced by institutional acknowledgement and support.

6.11.4 Is the ILC an appropriate curriculum for Radiography?

A curriculum in radiography must prepare students for the complex workplace of technological development and change in professional status and identity. In the process of gaining the clinical competence essential in radiography, the student must take on the identity of a radiographer. A curriculum that includes experience in and understanding of the clinical context is necessary for this as the contextual learning develops integrated knowledge required for radiography practice. However this practice knowledge is not gained entirely in the domain of the workplace and relies on information and learning from the academy as well.

To prepare competent health care practitioners there are radical and moderate approaches to curriculum renewal that overcome the rigid and non-creative education of traditional institutions.

PBL is a suitable curiculum but was not feasible in the environment of staff reductions and diminishing budgets. As a curriculum is delivered within a unique context, there must be a decision on what will work best for that specific environment. The ILC was proposed as a way to overcome the limitations of the traditional, subject-base curriculum, and to prepare radiographers for the modern workplace. This is an adapted curriculum in line with 'reflective eclecticism' (Posner, 1992) where there was adaptation to accommodate the circumstances of the particular context and the expertise of the academics. Each academic was encouraged to plan learning activities for problem-solving and skills development, including small group work with focussed problem-solving. The student centred learning environment promoted active, self-directed learning. The ILC responded to the need for the planned integration of generic competencies that were assessed together with professional outcomes through integrated assessment.

The curriculum therefore hinges on the integration of workplace competencies and relevant knowledge. The additional curriculum goal to integrate generic competencies becomes important in meeting the needs of the modern workplace. Through an integrated curriculum the students in radiography can be prepared for their role as professionals in the interdisciplinary health care team. Because an integrated curriculum prepares professionals with competencies to continue learning they will be equipped to build knowledge and lead the profession on a path of development.

I recommend that an integrated curriculum, with a learning focus, is the way to respond to the complex environment of the modern radiographer practitioner as it can. However even with consensus on the value of an integrated curriculum the debate on whether it is the curriculum process, the content covered or concepts developed that are critical for the development of radiographic knowledge continues.

6.12 Suggestions for further research

Continuous curriculum evaluation for quality assurance in higher education is essential in order that the analysis of the present curriculum can inform future curriculum revision. Further to this the pedagogical approach, assessment practices and collaborative spaces need to be researched and I suggest that future research should therefore include such questions as:

Is knowledge and ability in one site transferred to future contexts?

Is the process of problem-solving acquired through classroom activities of benefit to problem-solving needed for competent clinical practice?

What components of an integrated curriculum contribute most significantly to professional practice?

What combination of assessment methods, sources and instruments are reliable in measuring the ability of the students to perform as professional practitioners?

How does the nature of the partnerships of those involved impact on the implementation of an integrated curriculum?

How can the teaching and learning regimes be understood for the radiography environment?

6.13 Closing comments

On the whole students in the radiography programme responded favourably to the learning experiences of the ILC. The academics appreciated the support offered by being a team and working towards optimising the learning environment. This established academic working group continues with the challenge of change that is inevitable in curriculum development. They choose this, aware that adaptation of the integrated curriculum is highly context dependent and that they are now embarking on a journey of continuous review and adjustment to meet the needs of a transforming curriculum for a transforming context. They also enter this journey knowing that curriculum integration requires subject specialists to move beyond established boundaries. The motivation comes from awareness that as they move away from specialist subjects to learning area focus, pedagogy changes. This promotes the development of a more holistic approach to teaching, learning and assessment that can potentially benefit the students. However the academics cannot succeed in isolation. The successful implementation of an integrated curriculum has the essential requirement of highly skilled academics and practitioners, underpinned by a supportive and facilitative management. While a key strategic issue is the strategic cooperation between the higher education institution and the workplace/s the most important feature is functional cooperation between the academics and the supervisors or mentors in the workplaces that the students attend. These two parties must have a working relationship that moves beyond the narrow confines of each individual's disciplinary boundaries. As the compartmental walls of our comfort zones are dismantled all participants can potentially benefit as healthcare practitioners are prepared for the rapidly changing modern workplace.

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2001

Name:.. Year of Birth: ....
Matriculation Year: ....

Home Language: .... Other Languages Known: ....

Country of residence:...................... Home Province (if South African)...................................

Briefly describe what you have done since leaving school:
....
....
....

Please answer the following question in the spaces provided.
There are no right and wrong answers, just brief expressions of personal ideas.

CONFIDENTIALTY IS ASSURED

1. What do you know about radiography?
....
....
....

2. What do you know about the National Diploma in Radiography?
....
....
....

3. List the things you most want to learn as a student?
....
....
....

4. List the things that help you to learn.

   4.1 Learner qualities/activities
   ....
   4.2 Group aspects
   ....
   4.3 Lecturer qualities/activities
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5. What do you understand by the term "Outcome for radiography"?
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   4.3 Lecturer qualities/activities
   ....

5. What do you understand by the term "Outcome for radiography"?
....
....
....

6. Have you ever learnt something by teaching yourself? This could be a skill or knowledge?
Yes – Give 2 examples

No – Explain why you think you have not taught or cannot teach yourself something

7. Explain whether you have learnt things in the classroom, which have been useful to you outside the classroom in a different environment?

8. Have you ever used information in one subject/activity to help you in another subject/activity?
Yes – Give 2 examples

No – explain why think this is the case

9. Explain whether you find it better to do something yourself in order to know about it?

10. Explain if there is a difference, for you, in learning theory and learning a skill.

11. Do you prefer theory or practical work and why?

12. What do you understand by the term "integrated"?

13. What do you understand by the term 'Reflecting on an Experience'?

Thank you for your time.
Penelope Engel-Hills
1 February 2001

Annexure A2

Report on the Initial Questionnaire

IMPLEMENTATION OF OUTCOMES BASED EDUCATION (OBE)

A survey of students registered for the first level of the National Diploma Radiography at the Groote Schuur Campus of Peninsula Technikon in 2001.

STUDENT PROFILE

There are 30 students in the first year of the National Diploma Radiography at this satellite campus of Peninsula Technikon. The division between the radiography disciplines is Diagnostic: 23, Nuclear Medicine: 3 and Radiation Oncology: 4. No students were accepted into Ultrasound at the first year level. A relatively small number (37%) of the students came onto the programme directly from school. This means that 63% of the students have had some post-school life experience ranging form 1 year to more than 10 years.

Table 1. Years post-school that the 2001 students commenced radiography training.

Number of students	Yrs between school & radiography	%
11	0	37
8	1	27
6	2	20
3	3-5	10
1	5-10	3
1	>10	3

The male to female ratio for this group of student is 7: 23. This reflects the profile of the profession of radiography in South Africa, which is historically a career choice of females, but with a steadily increasing interest amongst the male population.

METHODOLOGY

A questionnaire was used for the survey. The questions covered aspects seeking to establish the students understanding and awareness of Outcomes Based education, Continuous Assessment and learning. The questionnaire was completed during the first day of attendance and the results can therefore be assumed to reflect a base line of understanding and opinion that was not influenced by in-put on the radiography programme. All students present on the first day were asked to complete the questionnaire. They put their names on the form to facilitate follow-up. Confidentiality is assured and only the author will have access to the raw data. An analysis was done for each question and the total adjusted where any respondents did not answer a question. The results are reported below.

RESULTS

26 questionnaires (87%) were completed and returned. Not all respondents answered all items and some items allowed for more than 1 selection. In the analysis each item or part of an item was considered independently such that the number of respondents is never more than 26 but can at times be less than 26. Where the number of respondents is less than 26 this is indicated.

What do you know about radiography?

There was generally a good idea that radiography involves working in a hospital with patients: 'working with patients', 'responsible for the well-being of patients' and a limited understanding of the technological aspects of being in radiation medicine in the 4 radiography categories: 'taking x-rays to locate any abnormalities', 'use radioactive material to examine the inside of the body', 'use radiation to treat of disease', 'scans to check irregularities in a person and to check the size and health of the baby'.

What do you know about the National Diploma in radiography?

The answers to this question give an indication of the students' understanding of radiography training and showed that:

3 students had a good understanding (12%)
4 students had a reasonable understanding (15%)
18 students had a poor understanding (69%)
1 student had no understanding (4%)

It appears that student radiographers in this group generally have a lack of knowledge about the training, which they are embarking on. The majority of the class (73%) had a poor understanding of the programme when they started.

List the things you want to learn as a student.

The questions focusing on learning were well answered and showed a depth of understanding amongst the respondents.
The results of this question are that there are two broad categories of desire in learning and:
18/25 students have a strong desire to learn career- focused information (72%)
This included the one student who expressed a desire to learn, '*how to apply what I have learnt*'. 5/25 students most wanted theoretical learning (20%)

The 2/25 (8%) students not represented by these categories i.e. career-focused learning and theoretical learning, reflect interesting learning desires as follows:

To focus on learning that equips him/her to educate the public about disease (4%)

To focus on personal growth as the main learning desire (4%)

1 student did not answer this question (4%)

List the things that help you learn.

In analysing the answer to this question I allowed for students who indicated more that one category by including their responses into all appropriate categories. Most respondents were self-limiting and gave an answer that could be categorized to one of the pre-determined categories but 8 students gave answers that fitted more than one category.

The pre-determined categories for facilitating learning were:

1. Related to self i.e. learner qualities and abilities
2. Doing/practical application
3. Related to peer group
4. Related to educator/lecturer

A shortcoming of this question is that the learning context was not specified. The very open question offered no guidance to the respondents with regard to the environment within which they were being asked to comment on what helped them to learn. However, the answers were valuable and showed that in terms of what facilitated learning:

The majority of students, 14 (54%), see their personal abilities/qualities as most significant for enabling their learning

8 (31%) of students consider that "*learning by doing*" is a key factor in their learning and two students in this category referred to "*relating theory to practice*"

3 (12%) of students rely heavily on their peers to support and facilitate their learning.

It was somewhat unexpected that educator/lecturer qualities and actions were indicated as important in facilitating learning by just 1 (4%) student.

Examples of the respondents' answers and the categories determined are given below:

1. Related to self

Quiet surrounding, ample time, work interests me personally, pressure ranging from extreme (stressed out) to little to not much, read again, understand, ask for help, put in effort, mind maps, learning by my mistakes, get back-ground picture, work at night, work hard, believe in yourself, attentive, prepared

2. **Related to practical/doing**

Doing practical work. "doing it myself", do practical on class work, doing rather than watching, practical part help, if I do it I don't easily forget, being active and doing, do and see for myself
Applying/relating theory in practice
Relate to daily life situations
Chance to apply theory

3. **Related to peer group**
Small group, in groups where all contribute and help one another, group-discussion

4. **Related to educator/lecturer (2 comments)**
Answer questions

"good" lectures (the criteria of what is good was not specified)

Explain whether you have learnt things in the classroom, which have been useful to you outside the classroom in a different environment.

In response to the question on whether things learnt in the classroom have been useful in a different environment:

20 students answered in the affirmative with clear explanations (77%)
6 answered in the negative (23%) and one of these included an explanation.

The 20 students answering Yes had responses that are learning outcomes that can be grouped as:

attitudes/values
knowledge
skills

Examples of responses in these categories:
Attitudes/values:
clear and positive, help others (old people/shop bags) care for others, cultural differences, self-confidence, not shy to express myself, oral – confidence, relationships/cross cultural – waitressing, respect.

Skills:
Application forms-answer. PC, team-work comm.-skills, computer skills, talk in front of people, interacting with others in all walks of life, time management, accounting very useful in family business.

Knowledge (recontextualised):
physics and biology useful in every day living, chemistry and cleaning agents, geography (Australia) – useful when traveling there
Biology – '*some has been useful*'
Maths – '*very useful*'

Have you ever learnt something by teaching yourself?

A majority of the respondents (24) answered that yes they had taught themselves something (92%) while 2 students (8%) felt that they had never taught themselves anything. These 2 both strongly voiced the opinion that there is only learning if it comes from someone else.

The spread of examples of self-learning experiences could again be categorized into attitudes/values, skills and knowledge. There were again clear examples in each response category.

Skills (majority):
Swimming, traditional dancing, piano, time management

Attitudes:
patience, commitment, cultural sensitivity

Knowledge (minority):
science (no science teacher at school), maths (UNISA student)

Have you ever used information in one subject/activity to help you in another subject/activity?

85% of respondents (22) answered in the affirmative regarding the use of information in one subject/activity being of use in another subject/activity. 15% of respondents (4) did not consider that there was ever a time when information of one subject/activity was useful to another subject/activity.

Explain whether you find it better to do something yourself in order to know how to do it?

As a profession, the education of radiographers is directed towards professional skills and knowledge and this question searched for opinion on learning practical skills knowledge.
3 students were confused by this question and their answers were not considered as part of the analysis.
Of those that answered appropriately, it was interesting to note that 11/23 students (48%) are definite that they prefer to experience something themselves in order to know how to do it. Another 11/23 (48%) are also saying yes but with some proviso e.g. 'you need to know it first and no one can live without being told by someone how to do a thing...'. 1/23 respondents (4%) does not consider experience important and states that you can learn in theory how to do something in practice.

Explain if there is a difference for you in learning theory and learning a skill.

The question related to a preference for theory or practical work similarly showed that 2 students prefer theory to practice while 18 have a definite preference for practical above theory learning. 5 respondents find doing theory and practice linked together is ideal and 1 respondent said that theory was preferred but explained with an example of practice.

What do you understand by the term 'Reflecting on Experience'?

Reflection is an objective in Outcomes Based Education (OBE) and in South African educational policy it is referred to within the context of Applied Competence and Critical Cross Field Outcomes. Reflection on experience and on practice and extending this to learning through this reflection process and adjusting one's practice is a skill that must be included in all higher education programmes and that will be beneficial to any practicing radiographer. There was a stated intention to develop the skill of reflection on practice in the curriculum reform process and therefore one question focused on this.

It showed that in this area:

4 (17%) have a good understanding
7 (27%) have a reasonable understanding
10 (39%) have some understanding
5 (19%) have no understanding

What do you understand by the term "Outcome"?

The respondents of this questionnaire demonstrated that the OBE message is out there. There was little clarity on what OBE is and rather vague notions about the concepts.

The answers indicated that:

2 respondents (8%) showed a good understanding
2 respondents (8%) showed a reasonable understanding
8 respondents (31%) showed some understanding
14 respondents (54%) showed no understanding

This question demonstrated a clear divide between the students who entered radiography directly from school and those with a break of even just 1 year. It appears that 2000 was an informative year as far as OBE was concerned. The 12 respondents with any understanding of OBE were the 11 students who came directly from school and 1 student who has had a year out of school. The 14 respondents with no understanding have had more than 1 year out of school.

Explain what you understand by the term "Continuous Assessment"?

Continuous Assessment is obviously a more familiar concept and the result showed that:

7 (27%) had a good understanding
7 (27%) had a reasonable understanding
8 (31%) had some understanding
4 (15%) had no understanding

Two pre-determined categories were identified for Continuous Assessment (CA) and these are an opinion that indicates an understanding of CA as:

Testing often – 15 (58%)

Frequent assessment to enhance learning – 7 (27%)

Examples of responses on the understanding of Continuous Assessment
Testing often
'Series of tests ....and not just an exam'
'Constantly assessed with tests and projects'
'Continuously tested with everything you learn'
'More tests ....to reduce strain at exam time'
'Being tested regularly on work done'

Frequent Assessment to enhance learning
'Tested regularly (tests, assignments and practicals) by educator to see how you are doing throughout the year'
'Regular tests to see if students need help and to give mark at the end, not exams but tests, assignments, practicals to help you learn and to make up marks'.
Tests and projects/assignments, which are marked and form your mark to make sure you work throughout the year.
'Lecturer checks your work and your understanding daily or weekly,' 'be informed of performance on a regular basis'

It seems useful to ask some questions an assessment and outcomes and this is recommended for follow-up data collection in order to contribute to the evaluation of the success of the curriculum with regard to enhancing the understanding of the underpinning principles of OBE and the integrated curriculum.

CONCLUSION
Continuous Assessment was introduced into the radiography programme in 2000. This was in preparation for the introduction of education by outcomes in 2001. The first year group of radiography students in 2001, at Peninsula Technikon, is the implementation group for an integrated curriculum as the instruction design.

Continuous Evaluation of the newly implemented curriculum is essential in order to identify shortcomings in time to intervene and make adjustments that ensure the continuation of the high quality of the programme. In addition to the weaknesses identified, evaluation will also acknowledge the strengths of the integrated curriculum so that they are continued and built upon in future years. Research will be conducted by means of questionnaires, reflective writing activities and interviews.

Penelope Engel-Hills – Senior Lecturer
February 2001

Annexure B

Questionnaire on Radiography Education and Training in South Africa

Dear Radiographers, Student Radiographers and Lecturers,

I would appreciate it if you took the time to complete this questionnaire. By doing so you will be contributing to improving radiography education. This will help future radiography students and the profession.

Please be assured that individuals will remain anonymous in this survey. Furthermore the confidentiality of institutions will be maintained for all reports, presentations and publications.

I am interested in your perspective. There is no right or wrong answer, only your opinion.

Read and answer each question from your position as a radiography **student**, academic/**lecturer** in radiography or clinical radiography **practitioner** in an institution that offers in-service opportunities for radiography students.

Thank-you for your time and effort. Once you have completed the questionnaire please return it in the stamped, addressed envelope, which was provided for this purpose.

Penelope Engel-Hills
February 2003

BIOGRAPHICAL DETAILS

Please mark the relevant block/s

Student	
Lecturer	
Practitioner	

Position Held								
Years in radiography	>10 Years		6-10 Years		3-5 Years		<3Years	

Category

Diagnostic radiography	
Nuclear Medicine	
Radiation Oncology	
Ultrasound	

Higher Education Institution

Durban Institute of Technology	
Medical University of South Africa	
Peninsula Technikon	
Port Elizabeth Technikon	
Pretoria Technikon	
Technikon Free State	
Technikon Witwatersrand	
University of Pretoria	
Other	

Clinical facility

The hospital/medical centre/practice you are attached to	

Radiography students are trained at this centre	Yes	No

INSTRUCTIONS FOR ANSWERING THE QUESTIONS

In the case of the open-ended questions please use the space provided for brief responses that reflect your personal perspective.

For the closed questions please select an answer from the list provided. In most cases there is an opportunity to add to the list if you wish to.

A. PEOPLE and THE PROFESSION

Think about radiography as a profession that you are in and:

1. List 3 ways in which radiography has/could benefit you.

   i...

   ii...

   iii...

2. What do you personally hope to achieve through the profession of radiography?

3. Is there a radiographer who you think of as a role model? Yes No

3.1 Why is she/he a role model to you?

B. RADIOGRAPHY PROGRAMME

When I use the term 'radiography programme' I mean all the aspects that contribute to the education and training of the radiography students over the full period of the qualification. It is, therefore, the subjects, the academic and clinical components and anything else that is part of the education and training plan. In some institutions this is called the 'course'.

Reflect on the radiography programme that is currently being offered at the institution that you are most familiar with:

1. This radiography programme is planned with the intention of achieving certain things. From your knowledge and experience what do you think that the programme you are familiar with hopes to achieve?

2. In your opinion what are the three (3) best things about the radiography programme?

3. In your opinion what are the three (3) major weaknesses of the radiography programme?

4. If you could play a role in planning the radiography programme, what changes would you make and what things would you emphasise?

We are interested in which course components/teaching methods are used in the programme that you are familiar with. We also want to know which of these you think are either helpful or not helpful.

5. Please select which was used or not used by indicating with an X

	Not Used	Used	Helpful	Not Helpful	Don't Know
Lectures					
Workshops with internal presenters					
Workshops with outside presenters					
Assignments					
Formative assessment					
Discussions					
Group work					
Clinical demonstrations					
Student presentations					
Specialist presentations/lectures from experts					
Case study assignments					
Journal clubs					

Other: *(please specify)*

5.1 Have the lecturers changed their method of teaching in recent years?	Yes	No

5.2 In your opinion, why do you think their teaching method has changed?

5.3 Do you think the changes have had a positive or negative effect?

6. Think about the training, in your category, at your current institution and rate your experience of the radiography lecturers according to the following scale:

Read the scale below and apply to each question:

3.Excellent and I would not expect any more 2.Adequate most of the time 1. Never what I expect Cannot say

The lecturers:	3	2	1	*Cannot say*
Show respect for others				
Respond with empathy to concerns raised				
Interact well				
Collaborate with others well				
Delegate effectively				
Delegate to develop people				
Include others in decisions				
Listen to the opinions of others				
Respond to the opinions of others				
Offer useful suggestions and options for change				
Make decisions through negotiation				
Motivate others				
Empower people				
Help others to help themselves				
Encourage others to remain open to new possibilities				
Support and encourage students progress towards their goals				
Observe students' work closely				
Provide appropriate and valuable feedback				
Provide timely feedback to students				
Understand radiography roles and functions well				
Have knowledge and skills appropriate to the job				
Use a variety of skills and techniques				
Are leaders in radiography				
Achieve their goals				
Have a medium term vision for radiography education				
Have a long term vision for radiography education				
Plan the learning environment to respond to the vision				

C. INFRASTRUCTURE for RADIOGRAPHY TRAINING PROGRAMME

Think about the training, in your category, at your institution and rate your experience of the technology provided for radiography according to the following scale:

Read the scale below and apply it to each question:

5.Excellent and I would not expect any more
4.Good but some room for some improvement
3.Adequate most of the time though much room for improvement
2. Poor and only sometimes adequate
1. Never what I expect
Cannot say

1.1 *I would rate the technology of these as:*	5	4	3	2	1	*Cannot say*
Higher Education Institution						
Clinical training site/s						
Radiographic equipment at education institution						
Radiographic equipment at clinical institutions						

1.2 Explanatory comments are welcome

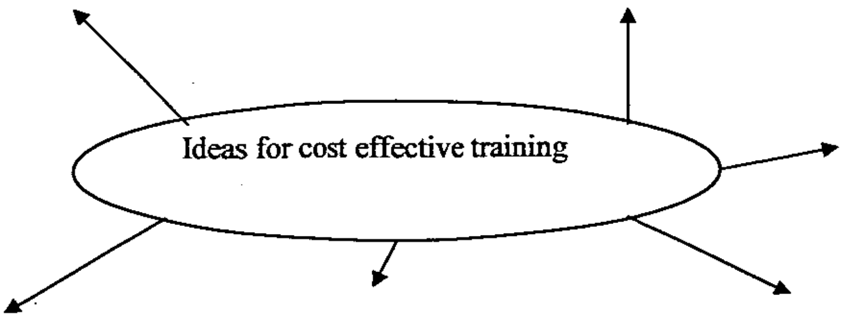
2.1 Should more money be spent on radiography training? | Yes | No |

2.2 Given your background and experience, what would you spend the money on?

More lecturers		Computer access for lecturers	
More clinical tutors		Computer access for students	
Radiographic equipment		Up-grading technology in classrooms	
Information resources		Student funding	

Other: (please specify)

3. Do you have any ideas or suggestions for a more cost effective way of training radiographers?



D. CLINICAL FACILITIES WHERE STUDENT RADIOGRAPHERS GAIN EXPERIENCE

1. Think about the training at your institution. Give your experience and ideas, what do you think are the most important and least important ways that students are prepared for the work environment according to the following scale. Briefly explain why you say this:

Read the scale below and apply it to each question:

3.Important and it works very well
2.Not so important but can work
1. Do not think this is useful

	3	2	1	Why?
Place in clinical department before any academic in-put				
Orientation to clinical department before academic in-put				
Cover introductory lectures before clinical placement				
Have academic and clinical on regular days each week				
Have academic and clinical on a week block system				
Have academic and clinical on a month block system				
Have semester block system for academic and clinical				
Lecturers do clinical demonstrations				
Radiographers do clinical demonstrations				
There are clear requirements documented for student learning during their clinical placement				
Radiography practitioners participate in determining the clinical requirements				
All students are given the same amount of time to learn the practice of radiography				
Use a system of student mentors in clinical departments				

2. In your opinion, what knowledge and skills does a student radiographer need in order to be successful in their clinical placement/s?

3. What do you consider the student' expectations of their clinical experience are in general?

4. In your opinion, are these expectations met during the clinical experience?

5. Is the view you expressed in 3 and 4 shared among your fellow students, practitioners or academics?

6. Using the rating scale below, rate each of the possible reasons for placing students in the clinical facility in the current training course you are familiar with?

Read the scale below and apply it to each question:

5. Definitely an important reason
4. An important reason but not the only reason
3. A Good reason but there are also other good reasons
2. A Poor reason
1. Definitely should not be a reason
Cannot say

	5	4	3	2	1	*Cannot say*
Their learning						
Service						
Professional Board registration requirement						

Other (please specify):

7. What, for you, are the four (4) most important things that ***can only be learnt*** in the clinical work environment?

E. ASSESSMENT of RADIOGRAPHY STUDENTS

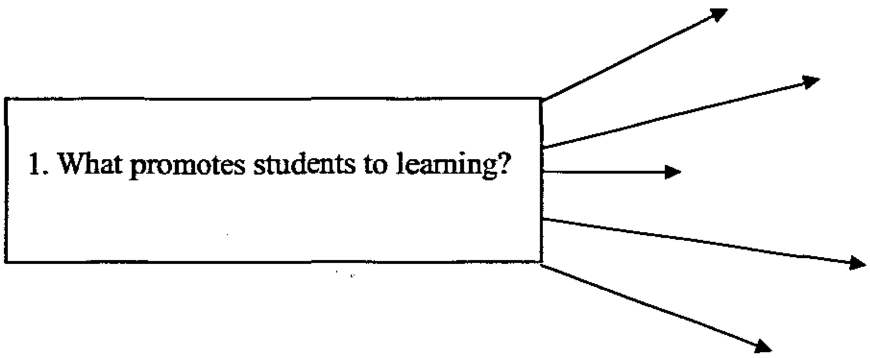
There are many ways that student radiographers are assessed. At the training centre you are familiar with this might include some or all of the listed examples?

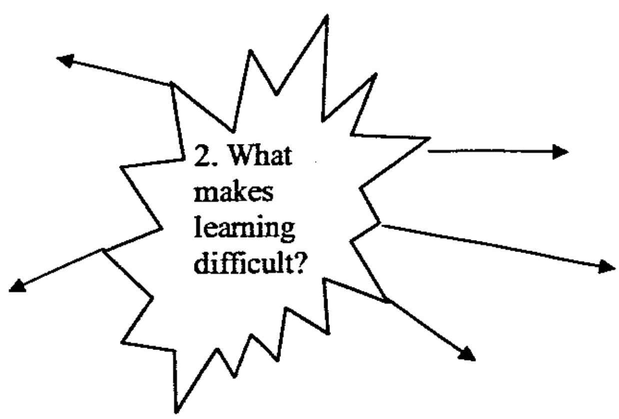
Assessment of academic skills/knowledge	***Assessment of clinical skills/knowledge***
Continuous assessment Formative and Summative assessment Summative assessment only Written tests on each subject Written tests that cover more than one subject Assignments for individual subjects Case study assessments	Continuous assessment Formative and Summative assessment Summative assessment only Clinical assessment on actual patients Clinical assessment on phantoms Objective Structured Clinical Evaluations (OSCE) Case study assessments

1. If there have been recent changes in the way radiography students are assessed please indicate what they are and say what you think of them.

2. What do you consider is the most effective way of assessing performance in radiography?

F: LEARNING





3. What generic skills are offered to radiography students in your institution?

Computer literacy		Communication skills	
Scientific writing		Information resourcing	
Numeracy		Cultural awarenesss	

Other: (please specify)

We want to learn about your view of the following observations, from your position as a student radiographer or from your interactions with students.

4.1 Read the statements and tick in the appropriate box:

Student radiographers:	Strongly agree	Agree	Disagree	Strongly disagree
learn more from their work placement/clinical practice				
learn more from the academic component of the course				
develop generic skills more effectively if they are taught as separate units				
develop generic skills more effectively if they are taught in combination with radiography knowledge and skills				
are dependent on lecturers to learn academic knowledge				
are dependent on lecturers to learn clinical skills				
are dependent on radiography practitioners to learn clinical skills				
manage their own learning in the classroom				
manage their own learning in the clinical environment				
are responsible for determining their own strengths and weaknesses				
are gaining the skills to become life long learners				
need the lecturers for guidance only				
need the lecturers to give them the content in detail				

4.2 Comments on your opinion of how student radiographers learn are welcome.

G: PROGRAMME DESIGN

We are interested in the nature of the radiography programmes offered in South Africa.

1.1 Select the appropriate answer by ticking in one of the columns for each of the statements that describe the radiography programme you are familiar with:

	Always	Mostly	Sometimes	Never
Subjects are taught separately				
Each subject is further broken down into manageable sections				
The focus of teaching is what has been determined as important for a radiographer in each subject				
There are subject specialists who teach the content				
There is a plan to have a common aspect/focus going through the subjects at a particular time				
The programme allows an in-depth investigation of the complexities of the discipline				
There is an attempt to connect previous teaching to the topic that is being covered				
The lecturers of each subject plan their teaching schedule so that appropriate common content or topics of each subject coincide				
There is shared planning and teaching of subjects/sections when there is overlap				
A common theme, eg respiratory system, is used to connect appropriate concepts, topics and ideas across subjects				
The radiography content is taught together with generic skills (thinking skills, social skills, study skills, life skills, cognitive skills)				
Teaching and learning is focused on knowledge and skills that can be used in real life situations				
There is team planning by lecturers				
All lecturers plan for teaching/learning of the identified radiography outcomes				
Where overlap between subjects/content is recognized a single lecturer teaches this				
There is subject specific content where in-depth knowledge is required for the discipline.				
Radiography students connect their past learning experiences and prior knowledge with the new information and/or skills being learnt				
Radiography students reach out to other students in a process of sharing knowledge and/or skills.				
Subjects are assessed individually.				
There is assessment through the use of project/s, assignments etc. that cover work from more than one subject				
Each subject is taught as a discreet unit				
The programme is taught as an integrated whole				
The course is delivered with the emphasis on the radiography profession				
Students are able to apply their knowledge in an environment different from where they learnt it				

1.2 Do you have any preference from this list or other items you might want to add:

My sincere thanks for taking the time to complete the questionnaire. Please place the questionnaire in the stamped, addressed envelope and return to me.

Penelope Engel-Hills
March 2003

Annexure C

Record of documentary Evidence

Document:...Date on document:.................
Date of scrutiny:...................

Contribution from this document to:

Description/framework of the integrated curriculum

Reasons for curriculum renewal.

Curriculum process.

Criteria for integrated curriculum.

How the curriculum meets the needs of our clinical departments?

The student centred approach.

Generic competencies.

To assessment in an integrated curriculum.

How this curriculum meets the needs of health care
in the Western Cape

in South Africa

Internationally

Curriculum evaluation.

Other useful information

Annexure D1

Reflections on Life as a Student from the Position of Employment

Use of Life History methodology for gleaning the 'new practitioner' perspective on working life in the radiography profession.

2 graduate radiography students of 2001 from Peninsula Technikon

First meeting - Friday 30 August 2002
Introduction to Niche and research project
Explanation of reflection process and how participants can use this to generate data
Written explanation handed out, read and discussed
Follow-up meeting arranged

Second meeting – Thursday 5 September 2002
Receive written reflections
Feedback on experience
Explanation of artefact and decision on hand-in date

Third meeting – Thursday 26 September 2002
Hand in artefact and discuss through open questions from reflective writings and artefact.

Annexure D2

Example of explanation given to practitioner participant

Reflections on Life as a Student from the Position of Employment

Thank-you for being willing to participate in my research. I assure you that your identity will be kept confidential by me. I also stress that you are free to decide to withdraw from this project at any stage without any pressure. The beneficiaries of my research will be future radiography students as this research can influence the development of the training programme. The benefit to you is less obvious but I will endeavour to introduce you to the process of reflection that you can develop if you so choose. It is my conviction that anyone who is a reflective practitioner will be a true professional, gain maximum satisfaction from their work and develop to their full potential.

The process of reflecting (looking back at your behaviour with the aim of understanding better) has been put forward by many academics. It is proposed that professional practitioners should reflect on their own behaviour in the work environment (ie the practice of their profession) and through this learn from themselves and modify their behaviour or develop in their profession.
For the purpose of this research I would like you to reflect on your time as a student radiographer at Peninsula University of Technology and Groote Schuur Hospital (including any experience at other clinical facilities). Through looking back try to learn something about the training programme and how it did or did not enable you to pratice as a radiographer.

In this process of reflection please write down any thoughts that come into your mind. Do not attempt to write a perfect essay. It is your thoughts and ideas that I need to hear as these will be my research data. As you reflect and write over the next 7 days take particular note of your work environment and the skills you use and consider whether the training course equipped you for the job.
You might like to include such things as; the high and low points in the training, what helped you as a 'new professional', what was missing from the course and what could we do that would help the new graduate to succeed. Maybe also reflect on why you selected radiography and whether you think it is the right career for you now that you are practicing.

Penelope Engel-Hills
30 August 2002

Annexure D3

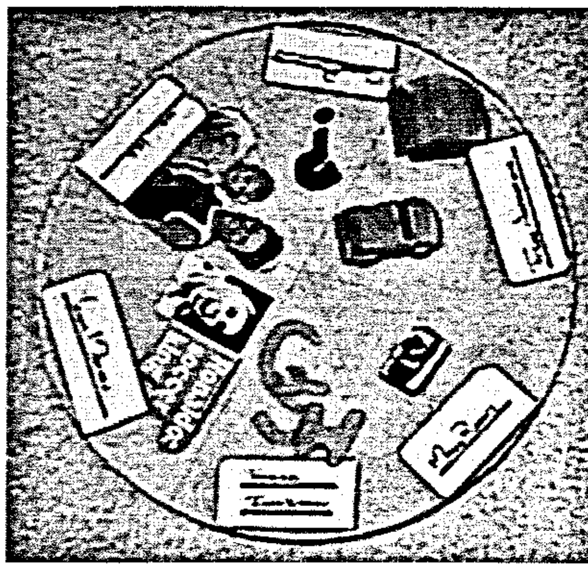
Example of instruction for production of visual evidence

Creation of an Image to represent yourself as a radiographer
This can be a drawing, collection of sketches, collage or in fact any graphic representation. The important thing is that you create something that represents you as a 'new practitioner'. Show the place of your training (or elements of your training) as well as other aspects that impact on you as a radiographer.
I will use this collage when I interview you about the training programme as I seek to gain a deeper understanding of you the 'new practitioner'.

Penelope Engel-Hills
30 August 2002

Annexure D4

A personal model prepared by a recent past student as a creative reflection representing the experience of being a student from the position of employment



Annexure E

Sample of Questions for Focus Group with Students

Date: ....

No. Students per level and category:
....

Time: ....to...............................

Semi-structured Questions

How do you understand your role as a radiographer in the department?

What are your aspirations as a radiographer?

How useful was/is your education/training programme to you as a radiographer?

What did you learn in the academic weeks?

What did you learn in the clinical weeks?

Are there any gaps you can identify in the training?

What do you think would improve this National Diploma programme?

Annexure F

Sample of Questions for Focus Group with Practitioners

Date: ....

No. Staff and Description of Group:

Time: ....to...............................

Semi-structured Questions

How would you explain/describe the integrated curriculum used from 2001?

Do you consider this curriculum is suitable?

Are there any changes you would recommend?

Annexure G

Quarterly Report on Clinical Experience

This is your individual assessment of the departments you have visited. It is compulsory to make this assessment at the end of each quarter (i.e. end of March, June, September and November) and return it to the School of Radiography.

Name: ....
Year: ....
Date: from: .... to: ....

List the clinical areas you have worked in during this quarter:

1....................................... **6...**

2....................................... **7...**

3....................................... **8...**

4....................................... **9...**

5....................................... **10.......................................**

On a scale of 1-10 rate the areas you have visited according to the criteria:
(1 = Poor - 10 = excellent)

Area	Learning Opportunities	Patient Care	Teaching	Radiation Protection Practiced

Comment fully on your clinical experience gained in these areas as follows:

1. Comment on the standard of the supervised teaching by the staff in these areas.

AREA	**COMMENTS**
....	....
....	....
....	....
....	....

2. **Comment on the variety of tasks you saw or did.**

AREA	**COMMENTS**
....	....
....	....
....	....
....	....

3. **Comment on the opportunities you were given to work independently.**

AREA	**COMMENTS**
....	....
....	....
....	....
....	....

4. **Comment on the attitude of the staff towards you?**

AREA	**COMMENTS**
....	....
....	....
....	....
....	....

5. **Comment on whether you managed to log the necessary tasks in your Log Book.**

AREA	**COMMENTS**
....	....
....	....
....	....
....	....

6. **Comment on which area you found the most interesting and why.**

AREA	**COMMENTS**
....	....
....	....
....	....
....	....

7. **Is there any area in which you feel you need to spend more time? Explain why.**

AREA	**COMMENTS**
....	....
....	....
....	....
....	....

8. **Are there any issues you wish to bring to the attention of the lecturers?**

AREA	**COMMENTS**
....	....
....	....
....	....
....	....

Student signature: .... **Date:** ....

Annexure H1

PROGRAMME EVALUATION

The purpose of this evaluation is to highlight strengths and weaknesses in the radiography programme. It is necessary to identify shortcomings so that appropriate remedial steps may be taken to improve the course and student performance.

INSTRUCTIONS:

Students are kindly requested to give their honest opinion concerning the items mentioned below. For this purpose only the appropriate number is inserted in the block accompanying each statement.

Select one of the following numbers in each case:

3 = Always 2 = Most Times 1 = Sometimes 0 = Never

1. [ ] Meaningful and appropriate out-comes/objectives were formulated for our training in radiography.
2. [ ] Student's progress was regularly assessed.
3. [ ] Additional outside resources were used for supplementing theory and clinical modules when necessary.
4. [ ] Practical/clinical experience is well integrated with the learning of the theory.
5. [ ] Resources (library books, journals, etc.) were readily available.
6. [ ] Most of the work learnt in theory can be applied in the practical/clinical tutorials or the department work.

7. [ ] The clinical tutorials were relevant and applicable to the actual working situation.

8. [ ] Working in the clinical department is an integral part of the training.

9. [ ] It was possible for me to judge my own progress from sources other than test results.

10. [ ] There was frequent lecturer-student interaction.

11. [ ] I had adequate, individual contact with radiographers in the department.

12. [ ] There were opportunities and learning activities that allowed me to co-operate with and learn from my fellow students.

13. [ ] Co-operation with fellow students was encouraged.

14. [ ] I was able to learn through a variety of learning methods.

15. [ ] This course has stimulated me to independent thought.

16. [ ] The environment promoted my personal development.

17. [ ] My academic development was encouraged.

18. [ ] Professionalism is stressed in this department.

COMMENTS WELCOME:

Penelope Engel-Hills
June, 2000

Annexure H2

LECTURER EVALUATION

LECTURER/FACILITATOR:

..

DATE: ....

Please take the time to complete this assessment since it will assist the lecturer/facilitator to improve his/her effectiveness as an educator.

INSTRUCTIONS:

Students are kindly requested to give their honest opinion concerning the items below. For this purpose only the appropriate number is inserted in the block accompanying each statement.

Select one of the following numbers in each case:

3 = Done very well 2 = Done well 1 = Could be done better 0 = Not done at all

The Lecturer/Facilitator:

1.	☐	Presented a structured and organised study guide.
2.	☐	Provided us with clear objectives for the subject/s.
3.	☐	Provided an environment conducive to learning.
4.	☐	Facilitates the learning process well.
5.	☐	Designed learning experiences at the appropriate level.

6. ☐ Was able to relate the learning material to clinical/ practical applications.

7. ☐ Provides a brief agenda at the beginning of each learning experience.

8. ☐ Exposes students to different learning materials/methods.

9. ☐ Ensures learning material is available.

10. ☐ Uses effective strategies to encourage active participation in class.

11. ☐ Encourages us to pursue special interests within radiography.

12. ☐ Makes time available for those of us who wish to consult.

13. ☐ Gives/Arranges extra tutorials when necessary.

14. ☐ Creates supplementary learning materials when necessary/requested.

15. ☐ Informed us at the beginning of the year how our work would be evaluated.

16. ☐ Uses realistic/effective methods of evaluation.

17. ☐ Gives feedback after each evaluation/assessment.

18. ☐ Uses results to identify which students need extra help.

19. ☐ Is enthusiastic about his/her subject.

20. ☐ Interaction with students is fair and consistent

If you had difficulty coping with this lecturer's material; was it because of?

- Inability to work on my own ☐
- Large volume of work ☐
- Poor/Disorganised presentation of material ☐
- Too little academic/learning time ☐
- Language difficulty ☐
- My study technique ☐
- My time management ☐
- Poor access to learning material ☐
- Other reasons ☐

Please specify
....
....

FURTHER COMMENTS WELCOME:

Penelope Engel-Hills
June 2004

Annexure I

Example of a Typical Year Plan

WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13
Year 1					ORIENT	ORIENT	ORIENT	ORIENT	ACADEMIC	ACADEMIC	ORIENT	ORIENT	ACADEMIC
Year 2	VAC	VAC	CLINICAL	CLINICAL	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC
Year 3	VAC	VAC	CLINICAL	CLINICAL	CLINICAL	ACADEMIC	CLINICAL	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL
WEEK	14	15	16	17	18	19	20	21	22	23	24	25	26
Year 1	VAC	ACADEMIC	CLINICAL	CLINICAL	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	CLINICAL	CLINICAL	VAC
Year 2	VAC	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	VAC
Year 3	VAC	ACADEMIC	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	ACADEMIC	CLINICAL	VAC
WEEK	27	28	29	30	31	32	33	34	35	36	37	38	39
Year 1	VAC	VAC	ACADEMIC	ACADEMIC	WARDS	ACADEMIC	CLINICAL	CLINICAL	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	VAC
Year 2	VAC	VAC	CLINICAL	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	VAC
Year 3	VAC	VAC	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	ACADEMIC	ACADEMIC	VAC
WEEK	40	41	42	43	44	45	46	47	48	49	50	51	52
Year 1	CLINICAL	ACADEMIC	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	CLINICAL	CLINICAL	CLINICAL	CLINICAL	CLIN/VAC	VAC	VAC
Year 2	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	CLINICAL	CLINICAL	CLIN/VAC	VAC	VAC
Year 3	CLINICAL	CLINICAL	ACADEMIC	ACADEMIC	CLINICAL	CLINICAL	CLINICAL	CLINICAL	CLINICAL				

Annexure J

Sample of text analysis towards thematic coding

COURSE		
Feelings	**+ve and -ve**	**Acknowledgement**
Selection nerve racking Hated interviews		Able to project myself
Bushed to the bone	Did not know what in for	Good way to familiarize
Hard to deal with Not fond of reading Boosted confidence	Dominated by self-study No-one checking up	Pushed me to greater heights
Strenuous Hard Huge strain Lot of work	More time All new Level 3 bad Big handful Lecturer preoccupied Fun=enjoy= learn	Bit much to do Too much to learn Try their utmost Essential basics taught well Fun, interesting Fully equipped

HEI		
Feelings	**+ve and -ve**	**Acknowledgement**
	IT limited small library few pc's slow, out-dated	
	Satellite problem	Not real students Enclosed in work environment
Ignored		Could make more effort

HOSPITAL		
Feelings	**+ve and -ve**	**Acknowledgement**
Tried hard	Good introduction	
Frustrating	Equipment broken	
Satisfied	Excellent training	Doing is good Helpful staff

PROFESSION		
Feelings	**+ve and -ve**	**Acknowledgement**
Proud	Good exposure	Real new profession
	Only we relate to patient need and feelings Separates us from the rest	Inner fullness
	Continuous learning career Advertize radiography to public more/do not recognize us Better to link to a Medical faculty	Radiography not limited
Feels right	Loving the job	Lot of opportunities Poor salary

Annexure J

Sample of text analysis towards thematic coding

COURSE		
Feelings	**+ve and -ve**	**Acknowledgement**
Selection		Able to project
nerve racking		myself
Hated interviews		
Bushed to the bone	Did not know	Good way to
	what in for	familiarize
Hard to deal with	Dominated by	Pushed me to
Not fond of reading	self-study	greater heights
Boosted confidence	No-one	
	checking up	
Strenuous	More time	Bit much to do
Hard	All new	Too much to learn
Huge strain	Level 3 bad	
Lot of work	Big handful	
	Lecturer	Try their utmost
	preoccupied	Essential basics
	Fun=enjoy=	taught well
	learn	Fun, interesting
		Fully equipped

HEI		
Feelings	**+ve and -ve**	**Acknowledgement**
	IT limited	
	small library	
	few pc's	
	slow, out-dated	
	Satellite	Not real students
	problem	Enclosed in work
		environment
Ignored		Could make
		more effort

HOSPITAL		
Feelings	**+ve and -ve**	**Acknowledgement**
Tried hard	Good introduction	
Frustrating	Equipment broken	
Satisfied	Excellent training	Doing is good
		Helpful staff

PROFESSION		
Feelings	**+ve and -ve**	**Acknowledgement**
Proud	Good exposure	Real new
		profession
	Only we relate to	Inner fullness
	patient need and	
	feelings	
	Separates us from	
	the rest	
	Continuous learning	Radiography
	career	not limited
	Advertize radiography	
	to public more/do	
	not recognize us	
	Better to link to a	
	Medical faculty	
Feels right	Loving the job	Lot of opportunities
		Poor salary

Annexure K

Glossary of some terms used in this thesis

Curriculum:	Except where stated otherwise the use of the word curriculum can be taken to mean, the locally planned teaching, learning and assessment activities designed to achieve the nationally determined, learner outcomes for a programme. It is, therefore, the negotiated process of the programme, which would vary according to the context and role-players.
Generic competencies:	Competencies required as education outcomes for every student. These are, therefore, key skills as opposed to competencies that are specific to a programme, profession or individual.
Integration:	The concept of 'integration' has no fixed definition and can vary according to the perspectives of a given institution or individual. This study analysed and interpreted the concept and offers a possible working typology for professional education.
Integrated curriculum:	A variety of teaching, learning and assessment practices, designed to facilitate the integration of knowledge, skills and key competencies as a cohesive package rather than by means of discreet sub-sections. For example, 'integration' is used to refer to interdisciplinary knowledge, reciprocity between theoretical and practical knowledge, work preparedness and the inclusion of key skills into the curriculum.
Integrated Learning Curriculum:	The particular integrated curriculum designed and implemented in radiography education that was the data source for the case study.
Interdisciplinary:	Working together to make decisions as a team of two or more practitioners representative of more than one discipline.
Interprofessional:	Members from more than one profession working and learning together.

Multidisciplinary:	Working alongside each other in a team that is representative of more than one discipline.
Multiprofessional:	Practice or learn alongside one another in a team or group representing various professionals.
Transfer:	The integration of acquired knowledge and experience and the ability to read and respond to the context with appropriate actions and decisions to achieve a desired outcome.
Traditional education:	A subject based programme. In radiography this is theory teaching interspersed with clinical experience.
Transdisciplinary curriculum:	Education that involves several disciplines and a team effort by academics and practitioners such that students learn within and beyond the confines of the higher education institution.