The impact of the VERT virtual reality system on teaching and learning associated with radiation therapy planning skills in the second year of the Bachelor of Radiation Therapy.

Paul Kane

May 2014

A thesis submitted for the degree of
Master of Health Science (Clinical Education)
at the University of Otago, Dunedin,
New Zealand
Abstract

The Department of Radiation Therapy, University of Otago Wellington recently acquired VERT, an immersive, virtual reality, radiation therapy simulation-based training system. The department has been integrating the system into the teaching of its undergraduate programme. Simulation has been used for a number of years in the training of health professionals and literature around this technique tends to be positive. Little has been written concerning the VERT simulation system in particular. This study aimed to investigate the impact on teaching practice and student learning, with particular reference to a Radiation Therapy Planning Concepts paper (RADT216) in the second year of the Bachelor of Radiation Therapy (BRT) programme. RADT216 requires students to develop the ability to generate and critically appraise treatment plans for a variety of scenarios. Given the VERT system’s inherent ability to visually represent information in novel ways, it is important to investigate student and staff perceptions around the impact of VERT on the teaching and learning of the concepts involved. This investigation should inform the continued integration of the technology into teaching this paper and the programme as a whole.

A constructivist grounded theory approach was utilised in study design, data collection and analysis. Data was collected from students and staff (both academic and clinical) responsible for teaching planning skills. Data was also gathered from one of the inventors of the VERT system. Students reported frustration with a lack of exposure to the system. They reported that the limited use they had of the system was hampered by a perceived lack of training and planning on the part of staff. Despite expressing dissatisfaction with their involvement in the integration of the system, students did express some empathy with staff and provided positive feedback. There were examples of useful experiences with VERT and students provided their insights into additional ways to use the system. Students did perceive there was sufficient potential in using the system to warrant continued development.

There were high expectations for the integration of the system into the BRT. Academic staff also indicated a variety of frustrations with initial efforts to integrate the system into their teaching. They
acknowledged the students involved in this study did not have the best experience with the system. Disparity in the training for and confidence in using VERT, insufficient time for preparation and limitations of the systems capabilities were indicated as contributing factors. Staff indicated they had learned useful lessons both on how to better use VERT and what to avoid. They had been challenged but were keen to continue integrating the system into their teaching.

Clinical staff had much a more limited experience and understanding of VERT. They did however anticipate a range of possibilities in the academic and clinical setting. They viewed the procurement of VERT as a positive step in keeping with recent developments in the BRT. They strongly identified with what they termed the theory practice gap and the ability of VERT to influence that.

The inventor was understandably pleased with the continued uptake of the system worldwide. Interestingly, there was some frustration with regard to how VERT was being used; particularly in the English setting where the system was first implemented in both academic and clinical departments. The designed intent of the system seems to align well with the intent of the teaching staff of the BRT in NZ. There was a desire to see as diverse use of VERT as possible.

This research has highlighted valuable lessons concerning both VERT and integration of new teaching approaches generally. The system does not represent a single solution to curriculum delivery. However used wisely, VERT may well be useful in bringing a more integrated approach to that delivery. There is evidence that a significant intervention such as introducing simulation-based teaching is more likely to succeed when all stakeholders are fully involved in the development process. A further indicator of success is the level of resource devoted to the implementation process, not simply procurement. There is evidence to suggest that in radiation therapy at least, the commonly held concept of a gap between theory and practice should be re-evaluated. The full potential of VERT remains untapped, however a number of avenues for future investigation have been identified.
Table of Contents

Chapter 1: Introduction
   1.1 Radiation Therapy ...................................................... 1
   1.1.1 Radiation Therapists in New Zealand ................................ 1
   1.2 Background to the study .............................................. 3
   1.2.1 What is VERT? ............................................................ 3
   1.3 Setting the Scene ....................................................... 6
   1.3.1 The work of a Radiation Therapist in New Zealand ............ 6
   1.4 Simulation as a means of teaching and learning. .................. 10
   1.4.1 The history of medical simulation .................................. 10
   1.4.2 Types of simulation .................................................. 12
   1.4.3 Virtual Reality and the Immersive Experience .................. 12
   1.4.4 Why use simulation? .................................................. 13
   1.4.5 Challenges with Simulation ....................................... 14
   1.4.6 Publications concerning VERT ..................................... 16
   1.5 Choosing the research question ...................................... 17
   1.6 Summary ................................................................. 19

Chapter 2: Method
   2.1 Research Approach .................................................... 20
   2.2 Methods ................................................................. 21
   2.3 Ethical Approval ....................................................... 22
   2.4 Participants ............................................................ 23
   2.5 Data Collection and Analysis ........................................ 23
   2.5.1 Student Participants ............................................... 23
   2.5.2 Academic Staff Participants ....................................... 25
2.5.3 Clinical Staff Participants ............................................................................. 26
2.5.4 The Inventor .................................................................................................. 27
2.6 Overall Analysis ............................................................................................... 27
2.7 Quality Assurance - Trustworthiness and Authenticity ..................................... 29
2.8 The Criteria of Trustworthiness ....................................................................... 29
  2.8.1 Credibility .................................................................................................... 29
  2.8.2 Transferability ............................................................................................ 30
  2.8.3 Dependability and Confirmability ............................................................... 30
2.9 Authenticity ...................................................................................................... 30
2.10 Summary ......................................................................................................... 31
3 Chapter 3: Results .............................................................................................. 32
  3.1 Student Results ............................................................................................... 32
    3.1.1 Focus Group Data ....................................................................................... 37
  3.2 Results Academic Staff .................................................................................. 42
    3.2.1 Teaching Philosophy and Influences ......................................................... 42
    3.2.2 Expectations and Perceived Challenges .................................................. 43
    3.2.3 Frustration ............................................................................................... 45
    3.2.4 What has been learned ............................................................................ 47
    3.2.5 Future Aspirations .................................................................................... 50
  3.3 Clinical Staff Results ..................................................................................... 54
    3.3.1 Motivations and Teaching Philosophy ...................................................... 54
    3.3.2 Main Themes ............................................................................................ 55
  3.4 Results from the Inventor .............................................................................. 59
    3.4.1 Motivators for development ..................................................................... 59
    3.4.2 Success and frustration ............................................................................ 60
    3.4.3 A Possible shift in teaching paradigm ..................................................... 62
  3.5 Summary ......................................................................................................... 64
4 Chapter 4: Discussion ......................................................................................... 65
  4.1 Has there been an impact? .............................................................................. 65
  4.2 The impact on the teaching environment ...................................................... 66
  4.3 VERT: Just another piece of Information technology? ................................... 67
  4.4 Simulation and VERT .................................................................................... 68
  4.5 Frustration ...................................................................................................... 71
  4.6 Varying Views of Stakeholders ....................................................................... 73
List of Tables
Table 2-1 Academic staff participant characteristics ................................................................. 25

List of Figures
Figure 1-1 View of LINAC and patient (www.varian.com) .......................................................... 3
Figure 1-2 VERT rendition of LINAC and patient ........................................................................ 4
Figure 1-3 Rt Hon Tony Ryall Minister for Health at the VERT official opening March 2013 ........ 4
Figure 1-4 VERT rendition of prostate patient ............................................................................. 5
Figure 1-5 VERT rendition of CT, internal anatomy & X-Ray beam ............................................. 5
Figure 1-6 Screenshot of section of typical prostate treatment plan .............................................. 9
Declaration

DEAUTHORIZATION CONCERNING THESIS PRESENTED FOR THE DEGREE OF

Master of Health Sciences (Endorsed in Clinical Education).

I, …………… Jonathan Paul Kane ……………………………………………….. (full name)
of ………30 Freyberg Crescent, Waikanae ………………………………… (address)

solemnly and sincerely declare, in relation to the thesis entitled:

………………………………………………………………………………………………………

(a) That work was done by me, personally

and (b) The material has not previously been accepted in whole, or in part, for any
other degree or diploma

Signature: ……………………………………………………………………. Date: …………………

To be included in Soft Bound copies only
Acknowledgements

There are always people to thank, but without the following this study would simply not have happened:

Dr Sarah Stein, for your patience, support, encouragement and steady direction
Dr Peter Gallagher and Pete Bridge, for wading through my heavy prose with the pruning knife of a different perspective.
My colleagues, for submitting to my endless questions.
My students, for being interested enough to tell me what you were thinking.

My wife, Patries Herst, for keeping faith with me when I did not provide you with any reason and for giving me the space and time to learn how to do this my way.

Paul Kane May 2014
1 Chapter 1: Introduction

This chapter outlines the context for the study. It will include the general setting for the discipline of radiation therapy and the specific context for the study. The chapter also serves to introduce the range of literature considered and the resulting study aim and objectives.

1.1 Radiation Therapy

Radiation Therapy is the use of ionising radiation for the treatment of disease. Alongside surgery and cytotoxic chemotherapeutic drugs, radiation therapy constitutes one of the main treatment options for the group of approximately 200 diseases commonly known as cancer (Washington & Leaver, 2010). Radiation therapy has been a treatment option for as long as the medical world has had access to radioactive sources and suitable X-Ray equipment (Washington & Leaver, 2010). While the technology involved in radiation therapy delivery has been refined, the physics principles on which it is based have remained the same (Joiner & van der Kogel, 2009). Healthcare professionals who administer radiation therapy as a treatment for cancer have different titles around the world and the specific tasks and skills they possess will vary depending on the model of healthcare being used.

In some countries these individuals are considered to be technicians who undertake training and education which allows them to follow protocols without significant levels of autonomy or decision making. Such technicians will usually work under the supervision of other health care workers with a higher level of training and education.

At the other end of the spectrum are those considered to be health professionals who undertake degree level education. This professional grouping will operate with greater autonomy. The expectation is they will have a skill set which facilitates greater input into the best ways to plan and deliver a course of radiation treatment. For example, such professionals will understand how to adapt to the inevitable changes which occur for a patient as treatment progresses. It is rare that these practitioners will function independently from those who have ultimate responsibility for the care of patients (i.e. medically trained radiation oncologists). However medical specialists tend to rely on the expertise and operational knowledge that radiation therapy professionals bring to the health care team.

1.1.1 Radiation Therapists in New Zealand

In New Zealand (NZ), those responsible for radiation therapy planning and delivery are predominantly trained to graduate level. In the NZ healthcare system, practitioners by law must be registered by a regulatory body and possess an Annual Practicing Certificate (APC) in order to practice. The renewal of the APC is dependent upon relatively unbroken employment within the
public or private sectors of healthcare provision. Evidence must be collated of the continuing development of an individual’s professional knowledge and skill base. It is usual that to meet such requirements, practitioners will have a Bachelor’s degree as a minimum. The group is given the professional designation Radiation Therapist (RT) (“Medical Radiation Technologist Board,” 2014).

New Zealand has only one education provider for undergraduate RTs. The course is a three year undergraduate bachelor’s degree course offered by the University of Otago from its Wellington campus (UOW). Completion of the programme leads to eligibility to register and gain a practicing certificate. The course is run from the Department of Radiation Therapy whose organisation can be viewed in Appendix A. The student body is small, with an annual intake of around 30 students. Teaching is predominantly delivered by departmental staff on a site physically separated from the rest of the campus. As the sole RT education provider in NZ this department produces new graduates for a highly specialised professional grouping which makes up a small but influential part of New Zealand’s healthcare system. At any time there are approximately 300 individuals registered by the Medical Radiation Technologist Board (“Medical Radiation Technologist Board,” 2014) and in possession of a current Annual Practicing Certificate in New Zealand.

The undergraduate programme, known as the Bachelor of Radiation Therapy (BRT), is designed to provide students with sufficient theoretical underpinning and clinical experience to enable them to function as “beginning practitioners” within the NZ system. A summary of the programme can be viewed in Appendix B. Throughout the programme students are expected to meet high standards in terms of; attendance, mandatory enrolment in all papers and “professional attitudes”. There are no opportunities for repeating failed assessments within the same academic year.

Whilst anyone suffering illness can be considered vulnerable, cancer patients are often considered to be a group with a particular set of challenges and vulnerabilities (“Cancer Society of New Zealand Inc,” 2014; Washington & Leaver, 2010). There is intense professional pride in meeting the needs of these patients from those within the academic department and the wider profession. In short, the Bachelor of Radiation Therapy is an intense, high pressure programme requiring much from staff and students alike (Department of Radiation Therapy, 2014).
1.2 Background to the study
In early 2013 the Department of Radiation Therapy (DeptRT) obtained a fully immersive version of the Virtual Environment Radiotherapy Training or VERT system. This system has been described as a flight simulator for radiation therapy and was conceived as a research project which involved four higher education and clinical institutions (“VERTUAL LTD,” 2014). A private company subsequently emerged which developed VERT to its current commercial level. In 2008 all tertiary education providers of radiation therapy training and all public sector radiation therapy centres in England had funding to purchase VERT made available by central government. Since then VERT has been gaining popularity around the world as a teaching tool for a range of disciplines involved in radiation therapy in both academic and clinical settings (“VERTUAL LTD,” 2014). The DeptRT at UOW determined that as a national education provider it was incumbent upon them to obtain what was widely considered the new standard in teaching tool for the RT profession (Appleyard & Coleman, 2008; Department of Radiation Therapy, 2009). After three and a half years of lobbying, funding was granted by the Minister for Health to purchase the system. The University of Otago and the Cancer Society of New Zealand provided additional funding to assist with the installation and integration of the system into the BRT programme.

1.2.1 What is VERT?
The VERT system is a high fidelity immersive simulator which sets out to replicate the clinical environment which RTs practise in. An examination of these terms follows later but for illustrative purposes: Figure 1.1 shows a Linear Accelerator (standard equipment used to deliver radiation therapy) with a patient being prepared for treatment. Figure 1.2 demonstrates the simulated view produced by VERT. Figure 1.3 illustrates how an individual might interact with the system.

Figure 1-1 View of Linear Accelerator (LINAC) and patient (www.varian.com)
Figure 1-2 VERT rendition of LINAC and patient

Figure 1-3 Rt Hon Tony Ryall Minister for Health at the VERT official opening March 2013
VERT then aims to simulate the entire radiation therapy environment; including the room where treatment takes place, the equipment used and the patient being treated. The system has further capabilities, as it is possible to visualise some aspects of radiation therapy not possible in real life. For example Figure 1.4 illustrates a ‘patient’ being set up for treatment to a cancer of the prostate. While Figure 1.5 illustrates that the beam of Xrays (1) used to treat the patient can be visualised. Along with internal anatomy via CT imagery (2) and particular anatomical structures of interest can be highlighted (3).

Figure 1-4 VERT rendition of prostate patient

Figure 1-5 VERT rendition of CT, internal anatomy & X-Ray beam
Simply put, the user not only experiences using the equipment but what happens inside the patient as a consequence of how they use that equipment.

1.3 Setting the Scene
To fully understand the aim of this study, an appreciation of the role of a practicing radiation therapist will provide background to the design of the teaching programme involved in delivering the BRT. It will also be useful to examine the concept of simulation in the wider educational context but ultimately in that of health science and the health professions.

1.3.1 The work of a Radiation Therapist in New Zealand
To reiterate, radiation therapy is considered a main treatment modality in the treatment of cancer (Washington & Leaver, 2010). A Radiation Oncologist will have overall responsibility for the management of the patient’s condition and will determine exactly which anatomical structures require treatment, the total dose of radiation used for the treatment and the period of time over which this dose is delivered. Together, these factors are known as the treatment prescription. Having been given this prescription, it is the role of the RT to recommend a plan for delivery and actually administer the course of treatment over the period of time determined by the supervising specialist.

Subject to variation, clinical workflow is divided into three main sections. The specific phrases or titles may vary but for the purposes of this description they will be termed:

1. **Pre-planning**,  
2. **Planning**  
3. **Treatment**.

The following summarises each of these sections. The reader may consult a more detailed description in Appendix C if required.

1.3.1.1 Pre-Planning
In this section patients undergo the preparation required for them to receive a course of treatment. This will be tailored to suit individual needs but for the most part will include the following:

- A briefing by the RTs as to what lies ahead and an opportunity for patients to ask questions.
- Using pre-determined protocols as a starting point, RT staff will determine the best way to position an individual patient for treatment delivery. Numerous data and measurements are recorded which will allow staff in the treatment section to reproduce this positioning every day.
• A CT scan is performed on the area of the body to be treated. RTs in the planning section use the CT scan to develop a plan for the best way to deliver the required dose of radiation to the anatomical area of interest.

• Completion of any additional measurements to accompany the CT scan.

• To permit treatment staff to accurately deliver treatment each day physical marks are placed on the patient’s skin. They are used with the aid of positioning equipment in a treatment room to correctly position and align the patient in relation to the treatment equipment. These markings can be simple pen marks but will usually include tattoos on the patient’s skin. (see Appendix C). In the head, neck and facial areas the need for tattoos is obviated by the use of an immobilisation shell. These shells perform the dual task of immobilising the patient and providing a location to place all positioning markings. (see Appendix C)

1.3.1.2 Planning
This part of clinical workflow is widely accepted as the culmination of all the theoretical underpinning in the training of a qualified RT (Washington & Leaver, 2010). The basic principle is that once produced, a beam of radiation will interact with whatever medium it encounters in its path, such as skin, muscle or bone. The outcome of that interaction will be the radiation dose deposited in tissue along the path of any such beam. Dose varies with a number of factors: the energy of the radiation beam, how much tissue is in its path, how far away from the source of the beam any tissue is, the specific type of tissue the beam interacts with and the length of time over which the interaction takes place. Like most organic materials there is a relationship between the dose deposited and the type and extent of the response of the tissue concerned. This response will happen to any type of cell, whether normal cells or the malignant cells in cancers. The cells in a cancer are often more sensitive to damage from radiation. They also tend to be much poorer at repairing themselves from said damage compared to normal cells. Such principles form the basis of radiobiology, the understanding of how ionising radiation interacts with biological material (Joiner & van der Kogel, 2009).

The intention is to direct a beam or beams of radiation at a patient in order that the dose to the cancer is maximised and any dose to apparently normal tissue is kept to a minimum. Such a balance provides therapeutic benefit. The most significant way to measure such benefit is the potential to kill the cells making up the tumour whilst leaving enough normal cells alive that the patient can recover and live disease free. As normal tissue is unavoidably damaged, treatment has side effects, which can be short term and transitory (acute) or occur in the long term and become persistent (chronic).
Radiation induced side effects depend on the body region being treated but can include: skin reactions, mouth ulcers, nausea, vomiting, diarrhoea, hair loss, pneumonitis, cystitis and neurological dysfunction. Patient quality of life both during and after treatment can be significantly improved if side effects are kept to a minimum.

Radiation therapy also has a role in palliation, the alleviation of symptoms and dysfunction which may be caused by advanced cancers for which cure is not a realistic outcome. Many individuals can tolerate severe reactions and the resulting discomfort if a cure is intended; this is not the case in palliative scenarios.

In practice an RT must develop a way to deliver dose to the targeted tissue whilst keeping to a minimum the dose received by normal tissue. A range of techniques and equipment are available to help achieve this aim. There are protocols to use as a starting point. However, each patient and their cancer is unique, therefore a customised treatment plan must be generated which adapts to that person’s individual requirements. The equipment and techniques have their limitations and a perfect solution rarely, if ever, exists. At this point the practitioner employs theoretical knowledge of anatomy, oncology, physics, human behaviour and research evidence to produce the best possible plan given the parameters set by the supervising specialist.

A treatment plan provides a set of instructions how to administer treatment. It also provides predictions where radiation dose will be deposited in the patient’s body if the parameters of the plan are met within an acceptable tolerance level. A plan could be compared to an architect’s blueprints which provide a set of instructions how to construct a building and indicate what that building will look like when completed to an exacting standard. Figure 1.6 provides a simple perspective of the predictions made by a typical treatment plan.
1.3.1.3 Treatment

In a timeframe ranging from a single day to seven weeks, the treatment plan is put into action in the treatment section. There is some variation of means to deliver radiation therapy but most modern centres employ a machine known as a Linear Accelerator or LINAC to deliver treatment. These are complex machines which are very expensive to purchase, maintain and staff. They produce the high energy X-Ray and electron beams required for radiation therapy.

When in the treatment room the patient will be placed on a couch and positioned relative to the LINAC so that the correct combination of radiation beams can be applied to the target region of their body. The couch and the LINAC itself are capable of a complex set of movements permitting a range of geometrical positions and arrangements.

The positioning process replicates the requirements of the treatment plan each time an individual treatment or fraction is delivered. A seemingly simple task, external positioning is only part of the process. Internal organs can vary in shape and volume from day to day, for example the lungs expand and contract whilst breathing. The volume of air in and out of the lungs during normal breathing is approximately 500 cubic centimetres per breath and occurs 12-18 times per minute in the average person. The tumour being targeted might be five cubic centimetres or less and located
within the body using measurement to a tolerance of two millimetres of distance. This presents a significant problem to be solved. A treatment plan must take such movement and inconsistency into account. The risk of inaccurate treatment delivery is inadequate dose delivered to the cancer which may compromise patient survival. Conversely, unacceptably high levels of dose may be delivered to normal tissue causing significant side effects and impact on quality of life and function both in the short and longer terms. Radiation therapists must understand the capabilities of their equipment and follow the instructions to deliver treatment as planned. They also must adapt as parameters change either during treatment (intra-fraction) or between treatments (inter-fraction).

1.4 Simulation as a means of teaching and learning.
The preceding section has outlined the significant demands placed on the cognitive and motor skills of a radiation therapist. These skills must be combined with significant interpersonal and professional qualities. To achieve the level required, it is usual for a training and education programme to have a mix of underpinning theory and clinical practice. This is common to many health professions. Skills are often described as being acquired rather than learned. The adage ‘repetition is the mother of a skill’ encapsulates the need to provide trainee practitioners opportunities to develop such abilities. There are many examples of occupations which require frequent practice of skills to achieve mastery, such mastery is often a precursor to being permitted to practise those skills independent of supervision. In the process of learning an occupation inevitably the learner will make mistakes, some of them significant. Healthcare disciplines have relied on an apprenticeship model of education in the past. This entails the concept of practicing under supervision using the ‘see one, assist with one, do one’ approach (Aggarwal et al., 2010; Kneebone, 2003). While the apprenticeship model has its place in the health professions, the concept of making mistakes to afford learning opportunities is not acceptable when people and their health and wellbeing are involved (Ziv, Wolpe, Small, & Glick, 2006). To enable students to learn patient centred skills safely, there is an increasing role for simulation.

1.4.1 The history of medical simulation
It is useful to develop a better understanding of the concept of simulation. A number of reviews have been written attempting to explain the background to and development of simulation in medicine and related disciplines (Berragan, 2011; Bradley, 2006; Kunkler, 2006; McCaughey & Traynor, 2010; McGaghie, Issenberg, Petrusa, & Scalese, 2010; Moule, 2011; Rosen, 2008)

A common first step when discussing the concept is to provide a definition for what simulation actually means. Bradley (2006) offers the following:
The technique of imitating the behaviour of some situation or process (whether economic, military, mechanical, etc.) by means of a suitably analogous situation or apparatus, especially for the purpose of study or personnel training.

Rosen (2008) provides the reader with:

An imitation of some real thing, state of affairs or process

While McCaughey and Traynor (2010) focus more on the application of simulation and suggest:

The provision of facsimiles of healthcare settings, which contain hospital artefacts to provide students with ‘mock’ experiences through which to practice clinical nursing activities.

All of these definitions embrace the idea that a simulation is something which is not real but which attempts to closely mimic reality, some degree of pretence is inferred. The question might therefore be asked, why would pretence be used in regard to subject matter as serious as an individual’s health? In response, many reviewers outline the origins of simulation on a more general level. The military have a long history using simulation; the game of chess was developed as a means of teaching the concepts of strategy and tactics used in battle (Rosen, 2008). Military use has gone on to develop simulation to much greater levels of sophistication to include what have become known as ‘wargames’ (Bradley, 2006). The aviation industry has a shorter but equally rich history with regard to simulation. The first practicable flight simulator was built in 1929 a mere 26 years after the first powered flight (Rosen, 2008). A third example is the nuclear power industry; the most superficial understanding of the nature of nuclear generated electricity will include some concept of the risks if a nuclear reactor were to malfunction. As Bradley explains, industries such as these where staff training or the testing of equipment or concepts would otherwise be too costly or inherently too dangerous will have a tendency to favour simulation (2006).

Referring back to the definition of simulation offered by McCaughey and Traynor (2010), it is a simple extrapolation to see why there has been such interest in medical circles regarding simulation. Medical procedures or interventions with varying degrees of associated risk have a well documented history of using simulation for training or testing (Bradley, 2006; Kneebone, 2003; Kunkler, 2006; Rosen, 2008) It is apparent the use of simulation in medicine predates even those examples cited previously. Kunkler describes examples of anatomical modelling dating back to ancient Greece and goes on to highlight use of simulation emerging from Renaissance times (2006). Simulation then has a firmly established place in healthcare education. The following sections will; outline the range of interpretations of simulation which exist, explore some of the reasons behind the utilisation of simulation and some of the issues confronting its use.
1.4.2 Types of simulation

It is a common perception that simulation entails the use of sophisticated equipment; flight simulators and similarly ‘hi-tech’ examples will reinforce this perception. It is important however to understand that simulation is a technique, not a technology (Gaba, 2004). Having established this idea, it is easier to understand the concepts of high and low fidelity. ‘High fidelity’ makes reference to techniques which utilise materials or equipment which are very similar to those used in the task being simulated. For example a high fidelity surgical simulator might utilise mannequins and the surgical instruments used in real life. ‘Low fidelity’ by contrast refers to a simulation which utilises materials or equipment which are not so close to those used in the actual task. An example of this would be a hypothetical discussion around the process of a nurse taking a patient history (Havinghurst, Field, & Fields, 2003). Regardless of the level of technology used, all of these techniques meet the criteria of mimicry or imitation of real life provided by the definitions of simulation found above.

A more refined classification of simulation types has been proposed which describes five groups or categories. These include: verbal, standardised patients, part task trainers, computer patients and electronic patients (Rosen, 2008). These categories can be described as high or low fidelity depending upon the equipment or material used. Role play is a verbal approach, standardised patients are a step further and might utilise actors to play the part of the patient. Part task trainers often utilise mannequins, models of the body or parts of the body to focus on particular tasks, ‘ResusciAnnie’ is a well known example (Laerdal, 2014). Computer patients might be computer screen based. The Otago Virtual Hospital is one example which generates interactive scenarios the student might experience in an emergency department (Blyth, Loke, & Swan, 2010). Electronic patients represent the highest level of sophistication and technology. These often integrate mannequins or Virtual Reality with computerised control and a rendering of the entire environment the scenarios are likely to take place in (Rosen, 2008).

1.4.3 Virtual Reality and the Immersive Experience

In some respects the emergence of computer and materials technology has allowed simulation as a technique to develop into something closer to its true potential (Rosen, 2008). Virtual Reality and the ability to create an immersive simulation environment is a case in point. Virtual reality makes reference to:

*a computer-simulated environment that can simulate physical presence in places in the real world or imagined worlds. Virtual reality could recreate sensory experiences, including virtual taste, sight, smell, sound, touch, etc.* (Wikipedia, 2014)
Advances in computer graphics and image projection technology have been largely responsible for making this iteration of simulation possible.

1.4.4 Why use simulation?
Having provided some explanation of what techniques fit within the definition of simulation, the next items to consider are the drivers behind the use of simulation. There have been a significant number of healthcare disciplines which have integrated simulation based teaching and learning into their curricula. The literature is extensive and includes examples of simulation used to teach surgical techniques, anaesthesia, dental surgery, inter-professional learning, emergency medicine, diagnostic skills, history taking and responses from critically ill patients in trauma centres (Blyth et al., 2010; Cook et al., 2011; Gurusamy, Aggarwal, Palanivelu, & Davidson, 2008; Kunkler, 2006; Littlefield et al., 2003; Paige et al., 2009; Stylopoulos & Vosburgh, 2007; Whelan, Spencer, & Dalton, 2009).

These studies serve to demonstrate the variety of disciplines and skills which simulation is used to teach. In spite of varying ideas as to what simulation means, common ground has been identified as to the potential benefits (as well as barriers) in the use of simulation (Bray, Schwartz, Weeks, & Kardong-Edgren, 2009). This study surveyed educators from a variety of health disciplines. They found strongly held perceptions that patient simulation was beneficial to teaching, learning and assessment across a range of domains. These included but were not limited to procedural skills, communication skills, interdisciplinary interactions and patient evaluation skills (Bray et al., 2009).

There has been significant reform in medical, nursing and other health discipline education in recent times (Bradley, 2006; Cant & Cooper, 2010). The reform is indicative of a move away from apprenticeship model education to one based on social interaction and experience, focused on quality of care for the patient (Bradley & Postlethwaite, 2003; Rosen, 2008). As educational theory guiding curricula has developed so too have the associated teaching and learning needs. Cioffi outlines a series of perceived advantages to using simulation. Experiential learning is made possible, learning is active, iterative and mimics clinical reality while removing the risk of failure (Cioffi, 2001). Such learning approaches can fall into the constructivist school of thought. This model emphasises a learning environment must be ‘safe’ for the student, permitting opportunities to try, fail and not be subject to derision or ridicule (Bradley & Postlethwaite, 2003). Kneebone and Kunkler (amongst others) discuss the ability of simulation based learning to provide such an environment for students (Kneebone, 2003; Kunkler, 2006). Learning experiences based in such an environment are more likely to be provide deep learning, therefore more likely to be lasting for the student (Biggs & Tang, 2009; Ramsden, 2003).
Perhaps the single most common driver for the use of simulation as a teaching approach is the desire to protect patient safety. Moule acknowledged that simulation goes beyond simple demonstration of clinical skills. Rather students may practice, receive feedback and ‘try again’ with the confidence that no harm will come to patients (2011). The focus on patient safety has arisen in no small part due to the reform which has occurred in medical and other health professional training. The changes have meant a refocus on the patient and addressing their needs (Bradley, 2006). What Bradley terms the ‘safety agenda’ has been brought to the fore in a series of publications (Health, 2000; Kohn, Corrigan, & Donaldson, 2000). There are instances of entire issues of prominent journals focusing on the topic of patient safety in health. Gaba is recognised as a pioneer of medical simulation and has discussed simulation based training in anaesthesiology as a model for patient safety in such an issue (Gaba, 2000). Ziv and colleagues have strongly advocated for the use of simulation based training to improve patient safety in healthcare delivery (Ziv, Small, & Wolpe, 2000). The group went on to further describe integrating simulation into healthcare training as an ethical imperative (Ziv et al., 2006). The article definitively placed the position of the patient as needing their health issues addressed, not to serve the training needs of the student practitioner.

1.4.5 Challenges with Simulation

1.4.5.1 Investment required but not always provided
The use of simulation has not been without its issues, some practical, others of a more philosophical nature. Bray and colleagues identified a series of barriers and challenges to integrating simulation into curricula (2009). McGachie et al characterised any such integration as not being ‘easy or intuitive’ (2010). Considerable investment of money and resource is required for successful integration of simulation into teaching and these publications highlight this is not always the approach taken.

1.4.5.2 Lack of conclusive evidence?
In her review of medical simulation history Rosen has pointed out that medicine is yet another example of a concerning phenomenon with respect to simulation.

No industry in which human lives depend on the skilled performance of responsible operators has waited for the unequivocal proof of the benefit of simulation before embracing it (2008)

There are other examples of reviews or studies where the evidence of benefit from simulation based training against not using simulation is equivocal (Cant & Cooper, 2010; McGaghie et al., 2010; Rosen, 2008).
There is concern that while students can successfully learn clinical skills using simulation techniques, there is risk that the patient is not fully considered in subsequent clinical practice; in a sense, simulation risks generating a false sense of reality. Such limitations can happen irrespective of the simulation being high or low fidelity. A simulation machine has limitations and may lack realism, using standardised patients may limit the variety of patient experience which may be encountered (Berragan, 2011). Such a limitation could be characterised as a failure in the transfer of learning. Norman et al conducted a review specifically examining this issue. They concluded that studies trialling simulation against no intervention do not clearly show a relationship between how material is taught and what is learnt (Norman, Dore, & Grierson, 2012). This represents a significant challenge. There is some contrast to the point of equivocal evidence in favour of simulation. Cook et al reviewed 609 studies and concluded there was no merit in further studies comparing simulation versus no simulation. This group argued a more useful direction would be to examine when and how best to utilise simulation in any teaching curriculum (2011).

1.4.5.3 The theoretical vacuum
Some of the studies discussed above illustrate a major philosophical criticism of the use of simulation based education; a lack of underpinning theory. Cant and Cooper suggested that while evidence existed of derived benefit there is still much to be learned with respect to effective implementation (2010). Bradley and Postlethwaite identified that a paucity of sound educational research is commonplace with regard to new ideas in healthcare training (2003). Berragan indicated that successful use of simulation requires awareness of the range of theoretical models of learning, there is no ‘one size fits all’ approach which can be utilised (2011). Gaba highlighted the lack of high level evidence confirming the benefits of simulation, he asserted the appropriate measure was data equivalent to a randomised clinical trial (2004). Reviews such as that conducted by Schmidt et al (Schmidt, Goldhaber-fiebert, Ho, & Mcdonald, 2013) confirm the reliance placed on high level quantitative study designs within health science. There is some unease with qualitative approaches. Despite this unease, many studies depend on self-reporting from students to measure the success of using simulation (Garrett, MacPhee, & Jackson, 2011; Gordon, Wilkerson, Shaffer, & Armstrong, 2001; Kuznar, 2007; McCaughey & Traynor, 2010). While this would not appear to be the high level data Gaba calls for, such studies are appropriate for educational research. Bradley and Postlethwaite highlighted that choosing an appropriate paradigm of inquiry for educational research is important (2003).
1.4.6 Publications concerning VERT

The existing literature on VERT as a simulation tool for radiation therapy training is very limited. This can be explained in part by the fact that the system only became available commercially in 2008. Additionally, Radiation Therapy is a relatively small discipline in the context of healthcare. The inventors of the system published articles concerning VERT. They initially described the development of VERT as a concept and later provided a description of the capabilities and features of the operational system. Some context was outlined as to the potential benefits of the system in the training of radiation therapists (known as Therapy Radiographers in the UK setting) (Phillips et al., 2008; Phillips, Ward, & Beavis, 2005).

Development of the system was with a series of partners in the academic and clinical settings and publications reported on this progress. Bridge et al published findings of a quasi-experimental evaluation. Their aim was to assess the success of VERT in aiding students to understand a complex task known as skin apposition (Bridge, Appleyard, Ward, Philips, & Beavis, 2007). There was acknowledgement that simulation lacked the feedback which would be gained in situations with a live patient. However the ability to practice the task without the burden of a live patient and the inherent constraints that brings was deemed useful by students. From a development point of view the study resulted in some suggestions for additional features which have found their way into newer versions of the system. Green and Appleyard published further work on developing skill using skin apposition as a technique (Green & Appleyard, 2011).

Three publications of an evaluative nature centred on how the system had been or was going to be used. Two focused on the English context (Appleyard & Coleman, 2008; James & Dumbleton, 2013), the third related to the system installed in Aarhus, Denmark (Boejen & Grau, 2011). Appleyard and Coleman wrote a report subsequent to the Department of Health providing funding so that all English education providers and public treatment centres could obtain a VERT installation. It was indicated that use of VERT was better developed in academic centres (2008). James and Dumbleton provided further insight into how those installations were used in the clinical context. They reported variation in the use of VERT between centres. Data suggested the full potential of the system was not being realised and was largely attributable to lack of resources diverted to implement VERT in the respective departments (2013). Boejen and Grau outlined some of the alternatives for simulation in radiation therapy training but centred their attention on the potential represented by VERT as a more comprehensive approach to radiation therapy simulation. No conclusive data were presented as the paper was more discussional in nature (2011).
Amongst the more recent publications is an article addressing the need for theoretical underpinning to the use of VERT. This was dealt to by using a specific learning resource as an example. The design and evaluation of the resource were explained in light of the specific theory of learning and teaching approach used to guide the development of the resource. This is the first publication concerning work to address the reported under-utilisation of VERT in the English context (Nisbet & Matthews, 2011).

The most recent article is by the inventors of the system and describes expanded use of the system outside of the motor skill familiarisation which is the hallmark of previously published work (Beavis & Ward, 2014).

From this summation of publications the reader can ascertain there remains much to be understood about simulation in general and VERT in particular. The existing material on VERT has two main themes; what the system hopes to be capable of providing and introducing students to basic clinical motor skills. If a particular user has developed an in depth understanding of the system and how to realise its full potential they have yet to publish such findings. Due to the extensive gaps in published understanding of VERT and its use there existed a broad range of topics which were worthy of investigation.

1.5 Choosing the research question
The study reported in this thesis was an investigation of the impact of integrating a new tool into the teaching of radiation therapy students. Investigation of impact is a useful step in the implementation of any intervention. This is no less the case in the teaching and learning environment. It could be argued that when significant resource is devoted to implementing an intervention whether that resource is financial or human, then the pressure to assess its impact is even more marked. In an environment where such resources are not limitless and there are competing interests, a certain degree of political pressure also contributes as a potential driver. In the case of obtaining and integrating the VERT system into the BRT at UOW all of these factors come into play. A small programme providing the sole source of a small yet very specialised group of health professionals has a particular pressure to “get things right”. After almost four years of lobbying to obtain the technology it was appropriate that the impact (if any) of its integration was investigated (Cohen, Manion, & Morrison, 2011).

The clinical work of a radiation therapist centres on the concepts and theories used to generate a clinically viable treatment plan for a course of radiation therapy. The pre-treatment portions of a
patient’s progress through any RT department are in place to obtain the data necessary to generate such a plan. Once planning has been completed, treatment delivery is the extended effort to deliver what was planned as accurately as possible over the period a course of RT runs. This can be anything from a single treatment (or fraction) to seven consecutive weeks of treatment five days a week. As such, the concepts which this planning process are built around are integral parts of the teaching and learning processes on the BRT.

The BRT is already designed and is adjudged to produce competent practitioners who are eligible for registration and licencing to practice in the New Zealand health system. Not only are the standards of the programme set at an appropriate academic and professional level for the NZ context but the level of skillset displayed by the typical University of Otago graduate means their training meets the required standard for practice in comparable jurisdictions such as Australia, the United Kingdom, Canada and many mainland European countries. As competence is determined to be the final arbiter of a practitioners standard of education and training it was considered inappropriate that any study would seek to measure or establish if integration of this technology would result in “better practitioners”. This would imply that those who went before were not up to standard or as competent and this is patently not the case.

Rather, what was being sought from this study was an understanding of what benefits were gained or problems were being encountered and what the experiences were of the various stakeholders connected to programme as integration of VERT into the BRT took place.

Additional factors influenced the focus of the study:

- The structure of the BRT means that different year groups are on campus depending on the timeframe within the academic year. The timeframe available to the researcher for data collection was when first and second year students would be on campus.
- Teaching staff in the department of Radiation Therapy at UOW had determined that use of VERT would vary according to the year group concerned. First year use would be directed to basic clinical skills. Second year use was more likely to involve use in the planning concepts papers.
- Studies and reports dealing to student preparation for clinical motor skills had already been published. It was therefore determined that using VERT with respect to teaching radiation therapy planning would be an appropriate focus for this study.
The research question therefore was:

**What will happen when staff attempt to integrate VERT into an already established academic paper which teaches radiation therapy planning skills?**

The aim of the study therefore was:

**To investigate the integration of the VERT virtual reality system in the teaching and learning associated with radiation therapy planning skills as part of an undergraduate radiation therapy programme.**

And specific Objectives which would meet this aim were determined as:

1. Critically evaluate the impact of integrating VERT simulation technology into the teaching and learning of treatment planning concepts in the BRT programme.
2. Understand the perceptions around such integration held by students enrolled in the second year Radiation Therapy Planning Concepts paper.
3. Understand the perceptions around such integration held by teaching staff involved in the second year planning concepts paper and clinical tutors who will interact with students following completion of this paper.
4. To relate the findings from the above objectives to teaching practices in the BRT and provide evidence based recommendations for future development.

### 1.6 Summary

This chapter has provided the reader an introductory understanding of: the function of a practicing radiation therapist; the context of the Dept of RT, UOW as an education provider for this profession; a brief history and background to simulation in the field of healthcare education and an introduction to the specific simulation system for RT training known as VERT.

This introductory material provides some background to and the rationale behind the research question which has led to the present study. The following chapter will elucidate the study design which was employed to conduct the research.
2 Chapter 2: Method
Having established the research question, aim and specific objectives of the study in the previous chapter, this section of the thesis details the reasoning and choices behind the study design. The chapter begins with an explanation of the author’s theoretical stance which determines the choice of methodology. The following sections detail the specifics of the study design, study participants, data collection, data analysis and an examination of the quality assurance mechanisms used in the study.

2.1 Research Approach
Once a research question has been asked the next step is to determine how this question will be addressed and answers sought. Undertaking a research project could be compared to a journey and all journeys must have by definition a beginning, an ending and a route which joins the two. The first task then is to determine the starting point. Ontologically, the author would hold that there is no one absolute truth or understanding of the reality which is who we are and how we function. As truth is not an objective reality, by definition, it will be impossible to find a single answer which is correct as there is no right or wrong in the context of understanding what is being experienced (Liamputtong, 2009). Epistemologically, constructivism is the position of choice for the author. That being; the world may exist independently of us but our knowledge or understanding of it and how we go about describing or explaining how we experience the world, is a construct of the mind (Guba & Lincoln, 1989). What this means in terms of selecting a method to address the research question is a need to have a flexible and pragmatic approach which permits the researcher to produce at the very least an interpretative version of what is being studied. While being interpretive this “version” can still provide a perspective which provides a plausible and coherent explanation of the data obtained (Charmaz, 2006).

Conducting research in an educational setting is only one of the scenarios in which making constructivist assumptions frees the researcher from some of the more limiting requirements of a positivist approach. For example, there is an acknowledgement that the researcher cannot remain completely removed or independent from what is under investigation or when describing what has been observed or recorded (Guba & Lincoln, 1989). Such descriptions will have been influenced by the existing ideas and experiences the researcher has, be they social, political, cultural or any other “al” one cares to mention. Rather than being a weakness or limitation, such a method enriches the interpretation, as those previous experiences and beliefs are useful in gaining a new perspective. The existence of such a perspective depends on the interaction between the researcher and the participant. In addition, holding that there is no one single understanding or truth, the constructivist
is by definition open to new or different possibilities to explain a given phenomenon (Lincoln & Guba, 1986).

A positivist or natural science approach would likely question such a method arguing that there is a need for rigour. That would imply the use of rigid design where hypotheses are generated and tested and all variables are isolated and controlled for (Cohen et al., 2011). Only through such approaches can there be assurance of study validity, reliability and generalisability of any results. However, such a perspective is underpinned by its own set of assumptions. First, that the area under investigation can be reduced to a finite series of variables; next, those variables can be controlled and the outcomes will be applicable removed from context and finally (perhaps most importantly to the positivist) the investigator can be isolated from all of these things (Cohen et al., 2011). As Lincoln and Guba discussed, rigour is only one construct or way to characterise a research approach and constructivism offers an option which they describe as analogous to scientific rigour.

“Thus, we have suggested credibility as an analog to internal validity, transferability as an analog to external validity, dependability as an analog to reliability, and confirmability as an analog to objectivity. We shall refer to these criteria as criteria of trustworthiness (itself a parallel to the term rigor)” (Lincoln & Guba, 1986)

2.2 Methods
It was decided to draw on a Constructivist Grounded Theory (GT) for the study design modelled on that described by Charmaz (2006). A number of reasons contributed to this being an appropriate approach to take.

A grounded theory (GT) approach is well suited to exploring complex phenomena where no prior ideas are held as to their nature. How this would be characterised and understood depends on the study design. GT provides a systematic means of developing a theoretical understanding of a phenomenon grounded in the data collected. In many ways, this is akin to what those following a hard science approach will do when they adapt or develop new hypotheses to fit emergent data as it is generated. By following a systematic process of collecting and analysing data trustworthiness can be ascribed to the study in a manner analogous to the rigour found in hard science (Charmaz, 2006; Lincoln & Guba, 1986).

The study involved students whom the author had taught and would at later times teach and have regular contact with. The study also involved members of staff who are colleagues and co-workers of
the researcher. It seemed naïve to think that some element of pre-existing ideas or perceptions or that those relationships would not have some bearing on the analysis of the data collected. Constructivist GT deals to this because it is assumed that any understanding obtained from the data is constructed rather than discovered. The approach not only allows for the lack of duality between researcher and researched, but embraces the influence of the researcher. It is the opportunity for interaction between the two which produces the resulting knowledge or understanding (Charmaz, 2006).

The Grounded Theory process in general readily accepts data of any sort or collected by any means, within the general principle of having structure and being systematic in nature. Not all data carries equal weight, but all is worthy of consideration when attempting to address a research question. The objectives that were established require an examination of a range of data types, and data which would by necessity (to be explored later) be collected using a variety of tools and approaches (Charmaz, 2006).

Grounded Theory provides the framework for an iterative process of developing an understanding of a phenomenon (Liamputtong, 2009). It would not be practicable to collect data at a single point in time or from a single source which would accurately reflect the existence or nature of any impact of implementing this technology into an area of teaching. All stakeholders, participants AND the researcher were involved in a learning process and the flexibility and pragmatism which the brand of GT Charmaz espouses allows the refinement of any investigation which is undertaken. In other words, the study could respond to the ideas and developments as they happened within different participant groupings at a variety of points in the time over which the study was conducted (2006).

Finally, the study was concerned with understanding the phenomenon of integrating a significant new teaching tool from the perspective of a number of stakeholders. Those perspectives are important and ultimately influence what the stakeholders do or do not. The phenomenon was in process, therefore it would be difficult to provide a ‘control group’ where stakeholders did not experience the change. Grounded theory is not bound by such concerns and instead utilises the interpretation of repeated examination of the data by the researcher (Bradley & Postlethwaite, 2003)

2.3 Ethical Approval
Ethical approval for the study was obtained via the Human Ethics Committee of the University of Otago. Approval was granted and the study was assigned the Ethics Committee Reference Number D13/285
2.4 Participants
As this was an investigation of an educational programme it was natural that the students are a major focus of attention; their learning being central to all the activity generated by the programme of study. It made sense that any design should take into account the experience of the student when considering the integration of VERT into the programme. For the purposes of this study, the entire cohort of 28 second year students enrolled in the second year Radiation Therapy Planning Concepts paper from the BRT programme were invited to participate in the study. Ten students responded to the first online survey. Nine students participated in the subsequent focus group. Due to participation being anonymous it is not known if these two groups comprised the same students.

Teaching staff in a number of roles also contribute. The academic paper which was the focus of the study was team taught by two members of the teaching staff within the department. Both of these staff members were invited to participate in the study.

Relatively speaking, VERT technology is a recent addition to the radiation therapy profession and is brand new to the New Zealand context. Within the department at UOW one member of staff was appointed as a lead in the implementation of the technology to the entire programme. This role requires close involvement with any implementation of the technology into teaching. This member of staff was also invited to participate.

Academic staff at the university are responsible for the entire programme and are based on campus. They work in concert with clinical staff who have day to day contact with student RTs while they are on clinical practice placements. Supervision and liaison with the university is provided by appointed Clinical Tutors on each clinical site but clinical staff who have no specific teaching remit, are also closely involved in student learning. An invitation was made to any such clinical staff to participate in the study. Two volunteers participated in the study.

An opportunity arose during the course of the study to obtain input from one of the three inventors and developers of the VERT system. A previously unanticipated visit by this individual to New Zealand provided the opportunity.

All staff (both academic and clinical) agreed to participate, as did the inventor of the system.

2.5 Data Collection and Analysis

2.5.1 Student Participants
Data collection from student participants were initially obtained using the SurveyMonkey online questionnaire tool. This data were collected in the early part of the second academic semester. An email invitation was sent to all students enrolled in the RADT216 paper. The email included a
participant information sheet (see Appendix D) and a hyperlink to follow to the online survey. Completing the 20 element survey was deemed to constitute providing informed consent. Appendix E details the questions asked. Using this tool allowed participants to respond to questions at a time and place suitable to them. This also constituted a medium they would be familiar or comfortable with. As it was impossible to link a particular set of survey responses to a particular participant this went quite some way to achieving anonymity for the students who took part. The researcher, also being a lecturer, affected the power dynamic between researcher and participant. By taking steps to provide anonymity to the students this provided a sense of safety for them and ensured the best possible data could be obtained to inform the investigation. The students could feel free to express their perspectives; this would result in data more reflective of where they stood as stakeholders and remove fear of disadvantage or adverse consequence. All 28 students were invited to take part in the survey and 10 responded to the email invitation. Data collected by this means was downloaded from the SurveyMonkey website to an Excel spreadsheet. This spreadsheet was imported in to NVivo for coding and analysis.

To build on the initial set of data gathered by the online surveys it was decided to utilise a more flexible medium to collect follow up data. This took place in the latter stages of the teaching semester. It was determined that a focus group would provide data that was richer and more reflective of a wider range of student views as the discussion could address topics participants wanted to raise as well as those predetermined by a schedule of prompting questions. An email invitation was again sent to all students enrolled in the paper. By doing so another opportunity to provide input was afforded to those who had not completed the online survey. The invitational email included a participant information sheet (Appendix F). A date and time were set for the focus group to happen. It was run in a venue that was a part of the campus remote to the Department of Radiation Therapy. An independent researcher was used to facilitate this group, someone not related to the programme, or familiar to or with the student cohort taking part in the study. The group was run on a semi structured basis. A series of prompt questions (which can be viewed in Appendix G), informed by analysis of the survey data was prepared to stimulate discussion but the participants were free to follow ideas as they developed. Nine student participants took up the invitation and contributed to the focus group discussions. Informed consent forms were completed by all participants and these forms were sent directly to the researcher’s supervisor for safekeeping. The discussion was audio recorded and the digital file was sent directly by the facilitator to the independent transcriber for verbatim transcription. This transcription was imported into NVivo for coding and analysis.
2.5.2 Academic Staff Participants

The university staff involved in teaching the academic planning concepts paper, as well as the academic lead in charge of implementing the VERT system were invited to participate in semi-structured, one-to-one interviews. The professional background of the participants is summarised in Table 1 below which outlines the breadth of experience teaching staff can call upon.

Table 2-1 Academic staff participant characteristics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Year Qualified as RT</th>
<th>Overseas Experience</th>
<th>Years working at UOW</th>
<th>Involvement in teaching/staff training</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2006</td>
<td>UK 4 years</td>
<td>1 year</td>
<td>8 years</td>
</tr>
<tr>
<td>2</td>
<td>1990</td>
<td>UK 3 years</td>
<td>8 years</td>
<td>20 years</td>
</tr>
<tr>
<td>3</td>
<td>1996</td>
<td>UK 6 years, Australia 2 years</td>
<td>5 years</td>
<td>18 years</td>
</tr>
</tbody>
</table>

This initial data collection occurred around the same time as the first student data was collected in the early part of the semester. Invitations were sent by email and included a participant information sheet (see Appendix H). It was determined that some of the measures employed with student participants were not required with university staff participants. The perceived risk was much less, as a position of power was not held by the researcher over this group of participants. In this instance, grounded theory provided a very useful platform to dig deep into the experiences and perceptions of the staff taking part in the study. The sense of collegiality which existed between the researcher and participants constituted a ready-made sense of rapport which enriched the data obtained. As the researcher comes from the same professional background, issues around commonality of language were negated. The interviews were arranged to take place in a venue and at a time and date of mutual convenience. A series of prompt questions were prepared in advance and provided to the participants prior to the interviews (these can be viewed in Appendix I). These were used as a guide only and each participant was free to express ideas and perspectives as they saw fit. Informed consent was obtained verbally and formed part of the audio recording of the entire interview which was then transcribed verbatim. The transcriptions were then imported into NVivo for coding and analysis.

A second set of interviews was then conducted with the same participants in the closing stages of the teaching semester some five months later. The same process of email invitation with participant information sheet was utilised. Again, the interviews were scheduled at a mutually suitable date, time and venue. As before, consent was obtained verbally and formed part of the audio recording of
the interview. The questions used to stimulate discussion were prepared in advance (see Appendix J). These questions were informed by analysis of the first set of interviews and the fact that a full semester of having the technology available had elapsed. In keeping with the semi-structured pattern of data collection discussion was free to explore ideas as they emerged. Recordings were transcribed verbatim, imported into NVivo and coded and analysed.

After analysis was completed, a summary of findings from this section of the study was sent to each participant individually and their comment was invited on how accurately they perceived these to represent their views. In accordance with Chamaz’s grounded theory process (Charmaz, 2006), points of concern or query were resolved by email or discussion.

2.5.3 Clinical Staff Participants
The university employs a member of staff to act as a liaison between the academic department and the various clinical centres around the country where students are sent to undertake clinical placement. This person enjoys strong links with key members of staff in each department. Using this clinical liaison as an intermediary, an invitation was issued for clinical staff to participate in the study and provide their views and perspectives. The invitation was to undergo a single, one-to-one semi-structured interview and was issued along with a participant information sheet and a list of questions deemed to be indicative but not prescriptive of the topics of interest for the interview. The questions were informed by the analysis of the student and staff data to date (these can be viewed in Appendices K and L).

Two volunteers were interviewed as a consequence of this invitation. One was a clinical tutor with direct responsibility for student learning in one of the smaller but very busy departments in New Zealand. The other was a senior planning radiation therapist in one of the largest departments. Whilst the latter participant’s role was not specifically focused on student training, student learning and progress through rotations in the planning section as well as the learning and continuing development of qualified staff in their department formed a significant part of their remit.

The interviews were arranged on a date and time of mutual convenience. These interviews were conducted after the teaching semester had concluded. As both participants practiced on sites remote to the researcher, the interviews were conducted by telephone. Consent was obtained verbally and formed part of the audio recording which was made of the interview. The recordings were transcribed verbatim and imported into NVivo for coding and analysis.
After analysis was completed, a summary of findings from this section of the study was sent to each participant individually and their comment was invited on how accurately they perceived these to represent their views. Points of concern or query were resolved by email or discussion (Charmaz, 2006).

2.5.4 The Inventor
One source of data which had not been anticipated at the beginning of the study was that of one of the original inventor and developers of the VERT system. In the latter half of the data collection period, this individual was present at a radiation therapy training event held on the university campus. Whilst this interview would not necessarily address specific aspects of the study objectives, this was an opportunity to obtain data which could potentially add depth to the understanding of the phenomenon under investigation. As well as being an inventor of the technology, the participant has a well-established background in the English healthcare system and extensive experience in academia. A formal invitation to participate in an interview was issued by email along with a participant information sheet and suggested question schedule. This schedule consisted of the following questions:

1. What can you tell me about the intended purpose of the VERT system?
2. Has this changed since the inception of the system?
3. If yes how?
4. If no, can you explain why this is the case?

Written consent was obtained prior to the interview commencing. The interview was conducted on a semi-structured basis using the brief schedule to stimulate discussion but the participant was free to explore ideas as they emerged. The interview was conducted in late November 2013. The recording was transcribed verbatim and imported to NVivo for coding and analysis. After analysis was completed, a summary of findings from this section of the study was sent to the participant and comment was invited on how accurately he perceived these to represent his views (Charmaz, 2006). No queries were raised. The outcomes of this interview are presented at the end of the results chapter.

2.6 Overall Analysis
The system for overall analysis of data was modelled on that described by Charmaz in her description of Constructivist Grounded Theory (2006). As each set of data was obtained, analysis was
conducted before the next data was gathered. Initial coding was done on a line by line basis so that all data could be attributed some quality. These codes were often descriptive or action based and tied to the specific data. As interviews were conducted constant comparison of codes was utilised as a means of checking and rechecking the data to identify common or emerging ideas as the data was gathered. A series of analytical iterations provided opportunities for unanticipated ideas to be identified and the line of questioning at the next interview could adapt accordingly. This could be considered something akin to the theoretical sampling which Charmaz recommends. This would be of particular value as at the time of the study there had been no previous work examining the use of VERT technology in the teaching of RT planning skills and concepts. This approach was also deemed to be useful, as the process of implementing the VERT technology into the programme was and is a work in progress. The ability to respond to developments with some flexibility yet within a structured methodology was important.

The analysis also utilised a second round of focused coding. This was the process by which the initial codes are distilled into more conceptual ideas. To assist with this stage of analysis field notes were used which had been recorded in a journal after each interview took place. An additional tool was the writing of memos when an idea was developing. These various notes and memos allowed the researcher to capture thoughts and reflections and to stimulate further consideration of the data as the analysis matured. As a whole, the codes, notes and memos provided a basis for how the various data compared, determined the fit of the coding to the data and helped crystallise the ideas which were emerging. These focused codes could then be sorted into categories which permitted the development of themes. The intent of the themes was to encapsulate not just what was happening but hopefully how and why (Charmaz, 2006).

The section above is intended to describe the process utilised in analysing the data, it may be useful for the reader to refer to Appendix N for further illustration if required.

Qualitative inquiry often seeks a point in analysis where saturation of the data occurs. Briefly, the point at which the researcher can determine that no further iterations of analysis or data collected will add to the ideas being developed. This analytical goal does make the assumption, in part at least, that time for analysis or access to participants for further data collection is not limited. In the case of this study both elements were limited. That said the analytical approach used, entailed repeated iterations of considering the data available. Additionally, data was collected over a number of time points in the course of the study and this provided opportunities to develop ideas and themes with participants and check if these were reflective of the perceptions being sought (Charmaz, 2006; Liamputtong, 2009).
2.7 Quality Assurance - Trustworthiness and Authenticity

It would be contradictory for a researcher to outline ontological and epistemological assumptions derived from a constructivist paradigm and then assert they have conducted a study whose rigour is assured by measures to provide validity and reliability based on demonstrable objectivity. Lincoln and Guba proposed a system of evaluation addressing the shortcomings of studies which depended on the positivist precepts of validity, reliability and objectivity. Instead they suggest considering alternative terminology which is analogous, rather than equal, to those mentioned above. These have been encapsulated as ‘Trustworthiness and Authenticity’ (Lincoln & Guba, 1986). As Schwandt has outlined, this proposal sits equally comfortably with other forms of investigation, educational research being one of them (Schwandt, 2007).

It is useful to point out that selecting a methodological approach (Constructivist Grounded Theory) born from a constructivist paradigm is both appropriate and a good match to the aims of the study (Bradley & Postlethwaite, 2003). Using the proposals from Lincoln and Guba as a reference point it is useful to outline those characteristics of the study design which can give the reader confidence of its strengths and acknowledgement of its limitations (1986).

2.8 The Criteria of Trustworthiness

The following are the specific points of interest outlined by Lincoln and Guba and describe how this design addressed those points (1986).

2.8.1 Credibility

The study was conducted over as long a period of time as permitted by the confines of an enrolment for a higher degree. This time period resulted in intensive contact with study participants and permitted time for event/time-sensitive data to be identifiable.

Being conducted over a time period rather than a specific instance allowed the pursuit of emergent ideas to obtain data which would confirm or dismiss them.

Data was obtained from a triangulated series of sources (permitting cross checking) which included all anticipated stakeholders connected to the phenomenon under investigation and indeed additional input from unanticipated but related sources when the opportunity arose. There was some variation in the means to collect data and some important data was obtained with input from a completely independent researcher.
The study has been conducted to satisfy the requirements of a research Master’s degree and as such the researcher has operated under the supervision of a collection of established academics. This has provided ongoing opportunities for peer debriefing and less involved or dis-passionate input to the developing investigation.

The design has, so far as possible permitted the researcher to cross check findings with the participants to test and check that the ideas constructed by the researcher are representative.

### 2.8.2 Transferability

In depth descriptions of the design, participants, data collection and the findings of this study are presented in this report. Alongside this, a detailed description of the context within which this study has taken place is also provided. This information provides detail so that the reader can determine the extent to which this study aligns with their own area of interest.

### 2.8.3 Dependability and Confirmability

What aspects of the study and its related data which can be made available under the limitations of ethical process have been provided in this thesis. The detailed description of the study design, rationale and execution serve to enhance dependability. The data, as reported, and constructions derived from it may be used to assess the confirmability of the findings.

### 2.9 Authenticity

Again drawing on the approach described by Lincoln and Guba, there are a number of criteria by which the authenticity of this study can be assessed. Some of the criteria are best assessed by the reader. The following however summarises characteristics of the design which respond to the criteria outlined (1986).

The study drew data from the range of stakeholders affected by the change under investigation. Effort was made to ensure all had a voice which was represented fairly. For example data was obtained from students in a manner removed from staff who might be deemed to have power over them. Staff and other participants had redress if required as to how their input was represented. The study was designed with acknowledgement of ontological assumptions made. The research was conducted in good faith irrespective of outcomes for the researcher and those outcomes will be disseminated. Subsequently it is the intention of the researcher that the findings of the study should inform further development or action around the area under investigation.
2.10 Summary
This chapter has presented a description of the study methodology and methods employed. It has outlined the range of participants, how data was collected and covered the steps taken with respect to quality assurance. The chapter serves to provide the basis for and the foundational ideas that governed the analysis and interpretation of the data now presented in Chapter 4 and discussed in Chapter 5.
3  Chapter 3: Results
This chapter reports the results from the data sources outlined in the preceding chapter. Four separate individuals or groups of individuals made up those data sources and the chapter is organised into sections reporting the results from each grouping. The section relating to student participants reports on the responses to a twenty element online survey (Appendix E) and the ideas and themes from a focus group conducted with student participants (see Appendix G). Staff results are divided into sections relating to staff with an academic role and those in a clinical role. These sections report on themes and ideas emerging from two individual interviews with each academic staff member (Appendices I and J) and a single telephone interview with each clinical staff member (Appendix L). Finally there is a section which reports on the ideas and themes emergent from the interview conducted with the inventor of the VERT system (see chapter 2 for schedule).

3.1 Student Results
Ten of the 28 students in the cohort responded to the online survey, a response rate of 36%. The first set of questions helped to ascertain what, if any, prior exposure participants had to virtual reality in any context. Question one of the survey asked if students had prior knowledge of the concept of virtual reality (VR). Thirty percent of participants (3/10) reported previous knowledge around the concept of virtual reality prior to commencing the Bachelor of Radiation Therapy (BRT) programme. When asked to expand on the nature of this knowledge in question two a variety of understandings of VR came to light. Common to all three was the idea that the concept was based in technology. The three participants provided; the entertainment industry (movies and theme parks), futuristic science applications and the training of pilots in flight simulators, respectively as their understanding of the VR concept. None indicated that they had anticipated using such technology during the BRT programme and one participant specifically stated they did not think they would encounter it in that context.

Responses to the third question “Prior to entry to the BRT programme, were you aware of the existence of virtual reality technology in the field of radiation therapy?” indicated that none of the participants were aware of a virtual reality system for radiation therapy training or education prior to admission on the programme.

Only twenty percent of participants (2/10) reported previous personal experience or interaction with virtual reality technology when responding to question five “Have you ever used any other virtual reality technology, either in a learning or entertainment environment”. Question six sought clarification of this and both participants reported these experiences as being in an entertainment context. One participant identified wearing 3D glasses in a movie theatre as a VR experience. The
other had used a flight simulator, specifically in the gaming industry but did not indicate if this was a fully immersive simulation environment.

The next series of three questions established some perceptions participants held around their own preferences around learning style. Eighty percent (8/10) considered themselves to be visual learners when asked to indicate this in question seven. Sixty percent (6/10) of participants reported that they enjoyed learning experiences in a group environment in response to question eight. The survey did not ask specific questions about other learning styles such as reading, listening or kinaesthetic approaches or if they were preferred. The two participants who did not consider themselves visual learners made up half of the group which reported that they did not enjoy learning in a group environment.

Participants were given an opportunity in question nine to explain in more detail what their preferences meant with regard to learning strategies. What might be considered a normal variety of styles and approaches was reported.

As might be expected when 80% of participants reported that they enjoyed group learning, this kind of scenario emerged regularly in the thinking expressed:

- Discussion is really important for me to understand different concepts...
- I enjoy learning in groups, especially in smaller groups so I am not afraid of asking questions.

It was in answering this question that students were able to identify preferred strategies other than those specifically mentioned in prior questions. A broader range of learning preferences were outlined illustrating that in this particular group no single learning style was dominant and that often participants were outlining learning preferences using a variety of approaches:

- I learn best by physically doing something and seeing something being done, such as vert so that it is more understandable and 'real'
- I like to have things explained to me and then I like to take my own notes as well as being given a set of notes or powerpoint.
- I prefer to learn/ study by myself as I need a quiet area and am often confused by others comments.
Some of the responses to this question indicated a level of maturity as a learner that would be expected at a 200 level course and contained elements of skill sets which the programme in general seeks to foster:

*Once I feel that I understand the concepts I am more confident*

*I need to reflect on things before I can take part in group discussions.*

There was also a level of qualification to responses to question eight, a more closed question about group learning. Participants provided insight into their particular expectations or ideas around group learning scenarios. These comments largely centred on the idea that group work was enjoyable in the right circumstances, especially those where all group members made a useful contribution to the learning process. A one sided or one way learning experience in a group was not deemed to be desirable or appreciated. For example:

*If I do not have my own grasp on a topic, I find that group study is unhelpful and makes me feel a bit anxious. I also like to be able to contribute to group study which I won’t be able to do unless I have my own understanding. Group study needs to benefit everyone, so I think it works better if everyone is at the same level.*

Context had now been established about previously held concepts or experiences in the area of virtual reality and how students in this study preferred to learn. Subsequent questions posed were specifically about VERT technology. VERT was installed during a time period this group of students was on clinical placement. The survey was run subsequent to the participants entering the Bachelor of Radiation Therapy programme but prior to experiencing VERT in the classroom environment. In response to question ten “Can you please describe what (if anything) you already know about the VERT system?” 70% of participants (7/10) reported they knew the system was a means of simulating or representing a linear accelerator, the standard piece of equipment used to deliver radiation therapy. How they expanded on this when responding to questions 12 and 13 was subject to some variation but fell into two main themes. One theme focused on the ability of the system to depict a linear accelerator with 3D technology. The purpose of this depiction was to demonstrate what happened during the delivery of a radiation therapy treatment:

*Not too sure, a 3D aid to help students visualize what goes on in the machine and in the patient...*  

*Assist students to learn in 3d*  

*A tool that can be used to simulate the technology of a treatment environment.*
The other main theme came from those participants who understood the technology was used to visualise what a treatment room and its equipment looked like and how it functioned. Such visualisation obviated the need to go to into an actual clinical department. It appears this group saw this function as a preparatory exercise before a first period of clinical placement. There was no indication as to any perceived benefit from the system after the clinical environment had been experienced in real life.

Allowing students to familiarise themselves with linear accelerators before going on placement

Learn how radiation therapy works and is delivered to a patient without having to go to the departments

Also of note are the responses to question 11 “Can you please explain HOW you came to know about VERT?”. All participants indicated they had received their initial knowledge of the system from briefings and information disseminated within the Department of Radiation Therapy. A single participant described having conducted further investigation into the technology using online search tools. No other participants reported accessing information other than that provided by the department. Only three of the participants indicated they were aware that the system was capable of representing the different brands of linear accelerator found in New Zealand clinical centres.

When asked about prior knowledge and to provide any suggestions around student expectations about the use of the technology in question 14, concern was expressed around the financial commitment necessary to obtain the system.

I would expect it to be used as much as possible since it was a big investment money wise.

I knew it cost a lot of money, what the purpose of it is and the problems/success it has had overseas.

While mentioned by a minority of students at this time, this idea was to resurface in a much stronger fashion during later discussion with participants.

A series of questions was then posed to investigate participant perception of their current radiation therapy planning abilities, what had contributed to their progress so far and what was needed to further develop those skills (Questions 15-19). When asked to rate their personal planning skills 60% (6/10) described themselves as being “Adequate” and the remaining 40% (4/10) placed themselves as being “Quite Strong”. All participants reported that their time in clinical practice had been instrumental in improving their planning skills. While participants expressed a variety of ideas concerning which aspects of their clinical experience were most influential, it was clear that the ability to see theoretical concepts applied in a practical manner was progressing their learning in a
significant manner. The theoretical framework constructed by year one of the course was successful, to the extent students were beginning to understand how ideas and concepts were linked together. This can be illustrated by the following comments:

- I got the chance to plan a range of sites and got one on one help with planning so I found that I learnt a huge amount during this time.

- Seeing things in clinical has reinforced my understanding of the concepts, and made me really understand the reasoning behind things.

Seventy percent (7/10) reported they had a good grasp of what was needed to improve their planning skills. Regular practice was viewed as being of real significance in progressing these skills. An opportunity to focus on planning a variety of scenarios and to discuss those with a critical mind was most likely to present them with a consistent series of learning opportunities.

- I guess just with practice and with each plan I will discuss and learn things with others.

- Practice plans and writing up a critique for each one

- Further practice on Eclipse, I think that by actually planning the plans planning ability is improved (N.B. ECLIPSE is a radiation therapy treatment planning system which will be fully explained in Chapter 4)

The final question of the survey (question 20) was open ended and invited participants to make any comments or suggestions they felt pertinent at the time. This prompted some of the more detailed responses within the survey. The overarching idea to describe those responses would be frustration and that frustration was multi-faceted. Participants appeared to be indicating their difficulty in subscribing to the wisdom of obtaining the VERT system. They understood it represented a significant investment of effort and resource to have technology such as this on site. Their exposure to date only served to undermine any confidence they might have in the system’s abilities and perhaps more worryingly (for them) the academic staff’s ability to use the system. They also displayed awareness of alternative ways to direct the resources expended to obtain VERT and seemed frustrated those options had not been chosen. Finally frustration was also manifest in what was perceived to be inadequate access to and use of the VERT system in the classroom. The following examples illustrate these frustrations:

- From the VERT demonstrations thus far, the staff do not seem very familiar with operating the VERT system
Very frustrated to not have had the experience on VERT which we thought we would have had by now. There isn’t much point in spending a fortune on something that is going to be used very infrequently. PLEASE give us some exposure to it!

At the moment VERT doesn't seem like it was worth all of the money spent on it as it only takes a day on clinical to learn how the machine functions and what buttons to press on the pendant. More computers or Eclipse on our laptops would have been much more valuable to us.

3.1.1 Focus Group Data
Upon reviewing the data available from the survey, it became clear that to better explore some of the themes which had emerged and obtain the necessary depth and richness of data a more flexible medium of data collection was required. As explained in chapter 2 a semi-structured focus group was therefore organised. An independent researcher was brought in to facilitate the group. Nine student participants took part in the group discussions. The group took place towards the end of the teaching semester. The resulting data allowed the study to develop a better understanding of student perceptions concerning the integration of VERT into the programme as detailed in objective two.

3.1.1.1 Frustration Persists
The sense of frustration was still very evident after a full semester had almost run its course. Participants in the group were very clear that the level of access and exposure to the VERT system had been completely inadequate in their estimation.

I just don’t think we’ve seen enough of it…..I think there’s things on there that we could be using it for, but we haven’t

like we’ve had like sneak previews of how it could be used, and like lectures be like –‘oh, we can use it- this-’ and then they don’t actually show us

Perpetuating the frustration was the student perception that the reasons underlying the lack of improved access remained the same. Primarily, the staff using the VERT system, were perceived to be lacking in the knowledge and skills to properly use it to its full potential. This sentiment was exacerbated by the recurrent perception that the investment of resource required to obtain the system was not proving a good one. The following statement provides some illustration:

I remember one of the lecturers saying ‘oh, we’ll use VERT at some point, but I haven’t been trained to use it yet,’ like ‘I don’t have authority to use it,’ so that was kind of like why we didn’t use it for the first month or so. But then after that, like you think they’d have trained up the staff to use it as best possible.

Exploration of the frustration felt by students led to reflection on how they saw the system was being used. Rather than being, for example, a source of pride for the students, it was instead
becoming something of a focus for resentment. When this was explored, students were fairly scathing in their synopsis of the drivers behind obtaining the system. They were acutely aware of the investment required to have VERT installed and again questioned the wisdom of that decision. It appeared to students that some groups were gaining some benefit from the system being \textit{in situ} but they did not count themselves amongst these. Participants also reported their frustration at the apparent lack of planning which had gone into integrating the system into the teaching programme and preparing staff for this task. They saw this approach as sabotaging the potential benefits of the system. The following will demonstrate these ideas:

\[
\text{they take lots of people, like on guided tours through it and stuff, like outsiders, but we haven’t really had that yet.}
\]

\[
\text{Yeah, I think one of the driving points, potentially, is the fact that the universities in Australia have it, all the ones in the UK have it, we didn’t have it. So now it’s like well, they’ve pushed and pushed and pushed for it, and now they’ve got the funding for it so let’s implement it, and that’s great, we’ve now got it, but, they’re not using it.}
\]

\[
\text{we’ve got to get through our course content as well as VERT, so...so, they’ve kind of brought it in this year, but without making any of the changes they need to make.}
\]

The introduction of the system into the department was in some ways a distraction to these participants. The idea of staff being ill prepared to handle the new system was reinforced by the limited experiences of the group, with staff reverting to default approaches which they were familiar with.

\[
\text{When we’ve used it in planning, it hasn’t used for much more than a projector. Which we already had beforehand.}
\]

\subsection{Students as Stakeholders in a Flawed Process}

The overall impression from these participants was that the implementation had, to date, been poorly handled and represented missed opportunities. One of those missed opportunities was that students did not feel they had been considered when it came to the process of integrating VERT into the programme. There was a degree to which students felt they were not trusted with the equipment. This would have been anathema to them as their discussions assumed the system had been obtained for student benefit and contrasted sharply with their experiences from clinical placement. Comparison with those settings was interesting. In the clinical setting they were trusted with equipment equally (if not more) delicate and expensive, albeit under supervision. Similarly they were trusted to interact with patients. One could readily describe these reflections as being those of
important stakeholders in the entire process of the VERT system being installed and integrated into the programme. From their perspective at least, being part of the process meant, by extension, their input should have been considered valid and worth seeking out. The following comments will provide some idea of these sentiments.

*I almost think it would be helpful to have a presentation on what VERT can actually do, to us students, and then let us go away and think about it, and come back and say ‘okay, well we think VERT would be good for this, X, Y and Z, but we don’t think it would be good for this and that, that it’s capable of.’ I think then that would nullify that problem of having no idea what it can actually do and can’t do.*

*But at the end of the day, we’re going into a clinical environment, which we’ve got million dollar machines that we’re working on anyway.....And we get trusted with those. And patient- real patients as well.*

It was poignant that the students seemed to regard the events around implementing VERT-based teaching as being unique to the local context. They were not opposed to obtaining the system *per se*, rather any issues with the implementation could be attributed to how it was conducted at a local level. It was not indicated if they were directly familiar with other institutions having the system but there was confidence expressed that these would have been more successful.

*They could communicate with other departments on how they utilise it, how they’ve improved, um, curriculum and that sort of thing, and integrated it in, better than what we have.*

3.1.1.3 Positive Responses from Students

The discussion in the focus group did provide some positive reactions from students relating to the VERT system and its potential.

Empathy with Teaching Staff

A certain amount of empathy was expressed for the position that staff found themselves in. Students seemed to link their perception that staff had not been prepared adequately, to the VERT system not being utilised in what they would consider a useful manner. They seemed to appreciate that the undergraduate programme still had to be delivered and it would not always be straightforward to integrate VERT. Whilst participants would undoubtedly prefer there was more use of the system, they were clear in their understanding that a learning curve existed for all the parties involved and the shape of that learning curve was time sensitive.

*I definitely think that if the lecturers knew how to use it, but were like more confident in using it, and could use all the tools, and it didn’t take so long or wasn’t so fiddly, then we would get a huge benefit out of it.*
But I think that comes also back to the lecturers being able to use it to its full potential. And then therefore if they knew its full capabilities and limitations, they could then implement it into their curriculum, and use it effectively.

When people have like more experience with it, it will be more beneficial, I think. And its still- I think it’s still in its early days

Clear Ideas around Learning Potential
Despite the frustrations about minimal use of the system, participants reported some insight as to how the system might be used. Students described how their learning needed to be well rounded and as their experience grew they should be able to relate each stage of learning to the various aspects of the clinical role they were preparing to take on. They could envisage how VERT had the potential to visually pull such aspects together to reinforce and deepen their understanding. Students seemed attracted to the idea of using VERT as a tool to help them broaden their understanding of the world of radiation therapy outside of the particular centres where they undertake clinical placements. For example:

In terms of access to VERT its more, like beneficial for like the big picture, rather than just for planning. Cause planning you can get a lot of that just from Eclipse, especially after- especially in stage two, I reckon. .......But I think VERT will enhance the whole treatment, delivery, sort of room aspect, how you’re going to set the patient up, whether what you’re doing’s feasible, kind of thing.

for each of the sites maybe we do our planning paper, and then have a plan up, and then see the process for what you’d go through, the patient, and setting up and the questions that we ask........Then the people from different departments can contribute, and that’s like a good learning process for us, for how it’s done across New Zealand.

Examples of Real Learning
Participants also acknowledged that any positive experiences were not confined to envisaging future or potential use. While examples were limited, they did have specific experiences which had demonstrated to them the VERT system does work as a tool to facilitate their learning. The following excerpts illustrate how the students recognised that these learning opportunities served to reinforce previous work and allowed them to consider ideas and concepts in ways which other teaching and learning tools would not be able to provide. The system did provide added value.

She pulled up a prostate plan and we went through from the start, like when you bring the patient in, what you discuss with them, and then how you set them up and all that ...... that was really helpful, if they brought that into the course more, I think that would be quite effective.
In physics we did a pretty good session with the, um, calibration and stuff, because some of us on clinical didn’t actually get to see the physicist using the equipment. I found that really helpful.

It’s also good to see where you’ve got overdosing, and what effects it’ll have on the patient, because of how close it is to the critical structures, and you can see that in 3D, so that’s quite a big help.

Improving Access and Future Use
When provided with an opportunity to do so, participants were vocal in their criticism of the situation to date. However, the discussion was balanced by; an effort to consider factors they could not always fully appreciate, enthusiasm for affirmative action and practical suggestions as to how future integration of VERT into the BRT programme could occur. There was acknowledgement that a resource which was so difficult and expensive to obtain should be properly protected but that should not restrict its use for either students or staff.

...not let us have access to it twenty four seven like we do with the labs and the computers, but at least let the students have access to it, to do what we want to do with it, while there’s lecturers on site, so if something does go wrong, you can always go and get a lecturer that’s on site.

I think that if it is like implemented to its potential, then it’ll like have huge benefits for the degree
3.2 Results Academic Staff

The following reports on interviews conducted with academic staff at two time points over the second academic semester in 2013. The first took place in August as staff began the teaching of the second year planning paper. The second took place in December after teaching had concluded for the year. The interview schedules for each set of interviews can be found in Appendices I and J. Quotes from participants are attributed to Academic Participant 1, 2 or 3 (AP1, 2 or 3)

3.2.1 Teaching Philosophy and Influences

None of the three staff who participated had full formal tertiary teaching qualifications, although two had completed relevant academic papers. The main drivers for them being in teaching roles were; extensive experience and expertise as clinical practitioners and having a strong interest in educating student RTs. None expressed a teaching philosophy in educational jargon but all had fairly clear ideas about the elements which comprised their approach to teaching and the reasons behind those. Their experience largely drew on their clinical work and their background as health professionals. Consequently those reasons were largely concerned with the desire to use methods which would lead to students meeting the standards of practice that these participants aspired to for beginning practitioners. The emphasis was very much student centred; focused on practical methods; immersed in the realities of what students could expect to encounter in the clinical setting and which would ultimately benefit the patients they would be interacting with. There was frequent reference to what they remembered as successful teaching strategies from their own student experience. Again, specific educational jargon was not always used but there was a definite aspiration for their teaching to facilitate, model and encourage students to utilise deep learning made possible by reflection and an awareness of the consequences of their practice for patients.

I kind of remember how it was for me as a student a little bit, and what I really enjoyed about the different lecturers that I had, and the styles I came across. (AP1)

I don’t have a philosophy as such because I don’t have any formal teaching qualifications, so everything that I’m doing, I’m thinking about what I would want, from a student RT, if I was clinically working with them, and what I would want from a beginning practitioner. (AP2)

Yeah, I think I’m definitely thinking at it from a clinical head perspective, because that’s where my experience is. It’s not a teaching or academic background. (AP2)

The degree of confidence each of the participants had around their teaching practice was subject to some variation. The variation was largely a factor of their length of service, whether that be in the clinical or academic setting. There was acknowledgement that some theoretical underpinning would undoubtedly be useful and there was mention of pursuing academic study for their own development as teachers. However, all participants reported confidence in their abilities and skills as
health practitioners and that was viewed as a strong starting point for the purposes of teaching others to fulfil that role. For example:

The confidence I bring as a teacher comes from that I’ve had many years’ experience in the clinical, so I’m very comfortable in the clinical environment, so I can bring that to the teaching. (AP3)

I am confident in my clinical knowledge and my ability to be able to impart that. (AP2)

In exploring these ideas the study was able to determine the authority which lay behind the contribution of these participants.

3.2.2 Expectations and Perceived Challenges

3.2.2.1 What are we dealing with?
There was discussion around staff expectations concerning the VERT system and its integration into teaching. Variation of thought as to what the system represented was reported. For example it was accepted the system was a simulation but a definition of what ‘simulation’ actually meant was not common to all participants with some discussion around vocabulary and semantics. Two staff suggested that simulation was already being used in the teaching of radiation therapy planning and the other disagreed.

Any kind of training where you are using some kind of perceived real life situation, but in a controlled setting. (AP2)

No, I actually probably feel that that is more real, it is the actual system, it is actual patient data, they are creating actual plans that could be actually used. So I guess my definition of simulation, that it probably not good. (AP3)

3.2.2.2 Expectations from Other Sources
There were indications of perceived pressure from sources other than teaching staff and student. It is hard to specify the impact of such pressure but it can be characterised as being a pressure to perform and show that the system represented a sound investment of money and resources. Participants seemed to be well aware of this and reported being accepting of the drivers behind that. The following exchange illustrates this well:

Participant: We have a financial duty to say is our million dollar investment an investment, or is just a very expensive toy? What is th-what is actually- how do we quantify what the value- potential value, however you want to word it, is for the department, the students, the profession, and then there’s- you have a duty to-

Interviewer: how much of that is a pressure to you?

Participant: Well it’s not. Um, well yes and no, I think we went out on a limb to get it. We said-so yes, we have a duty to the public who have paid for this, to actually evaluate that it was worth it.
And if-and what we’re using it isn’t then to look and look and look, to make it- to ensure that it is. Yeah, we did-we made a stand about it. And I think, you know, you have a duty to the public to do that, and to the students. (AP3)

3.2.2.3 Impact on Teaching
There was acknowledgement of the extensive effort required to obtain the system. It made sense that participants generally had ideas and expectations as to how teaching and learning would be affected by the availability of the system to the programme. Those ideas and expectations did not necessarily extend to revolutionary thinking with regard to delivery of the teaching programme, rather they appeared to be quite measured. Having the system was deemed attractive and in the earlier stages of the process of integration into the programme, participants seemed confident of how its implementation would progress, as the following will demonstrate:

I guess my expectations were that for certain papers it was going to add a lot of value to the teaching, so not new teaching, but an easier, or a more virtual way to teach what we were already trying to. (AP3)

The expectation was that we could get some very basic understanding earlier than we had been able to, and that we would then be able to extend the students in a way that maybe we hadn’t been able to before, at an earlier time, in their training. (AP2)

Yes, it’s as fabulous tool, it’s not the answer to everything. It’s not. It’s a tool. (AP3)

3.2.2.4 Challenges provoke a rethink
Further exploration with participants saw them report that initial expectations were soon overtaken by a rethink of how the system could be implemented into the BRT. They began to realise that obtaining the system was the beginning of a process not the culmination of one. A number of ideas stood out in particular at this point. One was that the simplicity of integrating VERT had been overestimated. A second was the necessary investment of time from staff, who already had a heavy workload, had been underestimated. A third realisation was that utilising the system was going to require staff to have a very clear idea what they wanted to achieve when using VERT. These lessons were perhaps not a complete surprise but it was evident that any initial ideas were now subject to significant revision. For instance it had been assumed that using VERT would automatically improve any teaching and learning experience, this was not proving to be the case:

I think initially we thought we would use it a lot for planning, and doing dosimetry in terms of dosimetric evaluation of a plan. It quickly became apparent, even during the training, that that was going to take a lot more time, to figure out what the best way was going to be to get the maximum value out-it wasn’t actually going to necessarily do what we really wanted it to do. (AP3)
...you have to know what you want it to do, and that you have had that background and that thought process, you can’t just come in and go ‘oh, I’m going to do this today,’ and expect it to be done. You have to do that preparation work. (AP2)

3.2.3 Frustration
Participants reported aspects of the implementation process which were proving to be frustrating. The frustration was not with respect to having challenges, rather that workable solutions were not materialising. Either that or solutions were unlikely to materialise without wholesale changes to how the department was organised and teaching responsibilities were distributed.

3.2.3.1 Centred on Students
Some of the frustration centred on the student experience with VERT. There was a clear sense of empathy for the position of students while staff dealt to the challenges of trying to fully understand VERT and integrate the system into the programme. Staff reported being aware the incumbent cohort of students were not gaining the maximum benefit from VERT. They understood and agreed that the primary driver for having a resource such as VERT was to provide an improved learning environment for the students and it was important that students could clearly see benefit being derived. They acknowledged this was not happening as well as it might and indicated this was not a situation they found desirable. This situation was tempered however with the view that students were probably not assessing the situation from a perspective of being fully aware of what introducing the system entailed. There were also questions raised whether or not students recognise the benefit to them of experiences they do have or if they could fully identify what their needs were in the first place.

It’s not for us, it’s for the students, so if the student experience isn’t positive, then there’s no value in it. (AP1)

Second and third years, I think definitely disappointed, that they haven’t used it as much as they would have liked. But I guess that was a timing factor as well, and the fact that you know, it was only recently installed, and people who needed to use it were using it. (AP2)

... they have fixed ideas, they’ve seen some practice that may or may not match with what we’re doing, or talking about, or- though I think conceptually yes, they are going to get value from it, whether they see it, I- it’ll be interesting to see. (AP3)

if you ask the students, ‘VERT’s great, we want to use it,’ if you said ‘what do you want to use it for?’ whether they could articulate that. I don’t know. (AP3)
3.2.3.2 Circumstances beyond control

There were major foci for frustration which were outside the individual participants’ control or influence. One focus was the limiting effect of workload distribution within the department. The VERT system was brought in to enhance an existing programme, not replace one. Participants were struggling with the balance of maintaining their already full teaching load with the need to invest time and energy for maximum benefit from the system. Particular reference was made to staff having part-time status and thus not providing the ideal circumstances to fully explore what was aspired to in terms of utilising VERT. Participants indicated a common response to being time-poor was to perform additional work, out-of-hours often off-campus. This was not a workable solution given the specific circumstances. Using or preparing to use VERT entails specialist equipment which makes up the VERT system. The equipment is only available on-campus and access was already limited as the physical space where it is installed is used for multiple purposes. There was a sense of resignation concerning this status quo:

*It illustrates to me that I need to be a bit more proactive in getting stuff prepared for them. Um, but you know, at the moment I’m finding that exceedingly difficult to, with the amount of time that I have available. (AP2)*

*Because at the moment, I just- yeah, don’t have enough time. And I guess if I had Eclipse off-site, I could do stuff out of hours. (AP1)*

*Well, I think, definitely for me, it has impacted on the fact that I haven’t had as much time to play with VERT, and to set things up, perhaps, as I would like to. And I- you know, that’s just on going. I think that, um, things take me that much longer to do because I’m not here five days a week. But, I guess that’s life. I can’t really do much about that. (AP2)*

It is worth noting that VERT does not come packaged with pre-prepared lessons or teaching topics. There are sample CT datasets and radiation therapy plans included but how these are utilised is very much up to the user. A simple organisational tool called Virtual Presenter is part of the system. This allows a user to predetermine some ‘waypoints’ with respect to selecting viewing options but lacks the sophistication of more widely known software such as Powerpoint. While this might be considered a limitation of VERT, an alternative perspective is there is relative freedom for the user to utilise the system.

Also beyond the control of participants was the growing realisation that VERT did not always possess capabilities that they expected or hoped for. Any future development of the software running the system is not for these participants to determine. Additionally, the training which the vendor provided does not specifically instruct clients how a particular aim might be achieved for a given set
of circumstances. The emphasis rather, is to familiarise clients with the interface the system uses and encourages the development of site-specific resources using the tools within the system. It was frustrating for participants that despite taking this into account, time exploring the design of a lesson plan would not necessarily result in a successful outcome. Successful in this case, meaning that students reach the level of understanding intended or reach it by an easier path when VERT is used as part of the teaching process. Indeed it had been discovered that existing teaching tools already in place, often provided the optimal means to convey the intended concept or idea:

What we would really like the system to be able to do is more comparative stuff, so with the dosimetry and things, an easier comparison of techniques, plans, set ups, that kind of thing, it doesn’t do that. (AP2)

there is more literature coming out, around the use of VERT, and it’s- a lot of it doesn’t actually fit with our particular program, and our teaching philosophy as a general program, to be honest……Um, I think you do actually have to try it out first before trying it out on the students. (AP3)

Some of those 3D elements and spatial awareness, ECLIPSE does perhaps just as well with some of those planning concepts. (AP2)

3.2.4 What has been learned
Participants reported the events of the academic year had been generally positive. A great deal had been learned, not just about the VERT system but their personal teaching practice and the approach of the department as a whole. These learnings can be broadly classified into positives, what had or could work well with respect to using VERT and negatives, what should be avoided or what the limitations of the system (at the time of the study) were.

3.2.4.1 Positive Learning
Participants reported they had been surprised when experiences which were not so rewarding for them as teachers had in fact garnered a positive response from students. The lesson here was to consider that teaching and learning are two separate entities which must be aligned for either to achieve optimal effectiveness:

Interviewer: That would have an impact on how students respond?

Participant: Possibly, yes. Yeah. I think they would think that it was um, a bit more organised. And less ad hoc. Um, but then in saying that, the feedback was- you know, hasn’t really aligned with what I thought, um, in terms of what the students have said. They’ve- they’ve enjoyed some of that ad hoc, looking at their own stuff. (AP2)
Levelling the field
It was indicated by participants that they perceived VERT as a useful way to “level the field” for students. Treatment planning is a conceptually rich aspect of the role of radiation therapists and those concepts are not understood in a uniform manner or timeline across any given cohort of students. Using the system had presented learning opportunities around these concepts which made it more feasible to progress the learning of the entire cohort as a group. This was in part explained as VERT providing different ways to consider the topic (often more visually orientated) and in part by opportunities for students to engage in peer teaching. There were elements of fun and novelty value involved in using the technology which teaching staff felt made the learning process less intimidating. They also appreciated efficiencies VERT introduced into their teaching. A useful example would be that VERT allowed them to present ideas in a manner which negated the need to have multiple conversations about the same topic with disparate individuals or groups of students. The following will illustrate:

*so some things um, can be a bit tricky to start with. And there will be some students who will- can get started on that, and will be mostly on the right path, and there’ll be some students who are not there. So it’s a really good way of getting everyone moving in a similar page to at least begin with. (AP1)*

*They’re learning it from each other, and because someone else is in the class and suggested that, they’re seeing that from a peer level idea, and that’s, I think, really good for their learning. (AP1)*

*I mean it’s an effective resource, cause it means we’re not spending the first hour of the class trying get the ones back on track who have ridden off. (AP1)*

Goal Setting is Important
From a teaching perspective, participants felt that the benefits gained from using VERT are more readily obtained when clear goals are set for what they want to achieve. Rather than be drawn to the novelty of using an exciting new technology, more can be achieved by deciding what it is the teacher wants to convey and then considering the best way to convey it. A good example comes from teaching staff attempting to encourage a holistic approach to learning from the students. They reported that a considered use of VERT rather than an ad hoc one seemed to be more successful:

*Being prepared, is the key thing that I’ve taken away from it really. If you’re not prepared, I just don’t think it’s worked particularly. (AP2)*

This is not without some inherent difficulty, a full understanding of what VERT can do is necessary before anyone can make informed decisions about its use. A potential benefit however is the motivation to better understand VERT and the teaching strategies they were employing. In the
broader context this served to aid participants’ understanding of their specific needs and how they might go about addressing them.

*Talking to staff who have maybe indicated that they want to use VERT the question is well what do you think you want to use it for? ..... What is it that you really want to achieve? And quite often it in those conversations you’re able to determine well actually this isn’t the tool for that, or actually, it is the tool for that, be how about we go this way, slightly with it, or it will work really well if you do it this way, we think.* (AP3)

**A Collective Approach**

Participants provided insights indicating the way VERT is integrated across the whole department should be subject to a more coherent approach. There had been some effort to do this but the original plan was probably not as effective as intended. Participants offered a sense that individuals were taking their own direction in utilising VERT, yet suggested that should the knowledge being gained be treated in a more coherent fashion, progress would be more rapid. Training in the use of the system was inconsistent between staff and there was little evidence of communication between those responsible for different subject areas where VERT might be utilised. This could be characterised as a lack of distinct leadership in what was a significant department-wide project:

*Personally, I would like a little bit more training, like I’ve only seen of VERT what’s been done here. Um, so, like I- I don’t- I haven’t used virtual presenter, really, and would really like to use- know how to do that.* (AP1)

*There’s been no kind of formal forum where everyone’s gone ‘well this is what I’ve done with VERT, this is what I’ve done, this is what I’ve found,’ I think individually we’ve probably had those conversations. But nothing’s been a collective.* (AP2)

*I think maybe if we all know what we’re doing with different papers, and how we’re linking it, that- that is bigger picture and those connections might be made a little bit sooner.* (AP2)

### 3.2.4.2 Negative Learning

What has been termed “negative learning” was negative in the sense of identifying pitfalls or aspirations which were deemed to be unreachable but nonetheless represent progression of understanding. Participants indicated they had identified some examples where VERT would not necessarily add any value or make things easier for students to understand. Whilst other data have indicated the system has enormous flexibility and capabilities, participants have satisfied themselves that VERT is not a tool appropriate to every situation. The following shows the strength of this lesson:

*No, one size does not fit all. I think is what we’ve discovered as well, in the end.* (AP2)
A year down the track, we actually have a clearer idea of how it’s probably going to fit in our curriculum, and that it needs to be tailored to each paper, I think, rather than the more generic approach. (AP3)

We thought that if we bought it up on VERT, we would really be able to demonstrate it ….. it didn’t make it as clear as we had thought it would, and I think in the end I found it was easier to use Eclipse to demonstrate that point. (AP1)

I don’t think it should be part of every lesson, no. (AP2)

3.2.5 Future Aspirations
The experiences of the first year of having VERT in the department has given participants some basis to reflect on how they might develop its use, both in terms of their own teaching and across the department as a whole. The particular focus of this study has been around the use of VERT to contribute to the teaching of planning concepts, which had been indicated by participants as the area of interest which seemed the natural place to direct efforts to integrate VERT. Their experiences appear to have shown that whilst not incorrect, this approach was somewhat limited.

3.2.5.1 Individual Teaching Practice
With respect to reflections on their own teaching practice and what direction they might take in the future, participants indicated they have already begun to think how they might use the system in other papers they are involved in teaching. Their ideas, while aiming to expand on which papers VERT is used to support, also entail demonstrating the links between those papers more clearly to students by the use of VERT. An increased awareness of what the system can and cannot do has led to a growing sense of confidence to attempt further used of VERT. Demonstrably the learning experience has not just been for the students. There was also discussion around further development of peer and reflective learning from the students with VERT being the tool all stakeholders have in common to achieve this. The following should illustrate:

I think that’s because I’m more familiar with it. You know, like I’m- I want to use it more, and now, um, I feel like I’ve got more time, and experience, and some more ideas for it, so you know, it’s- it’s- I don’t know if I’ve changed my mind about the system, but I’ve certainly changed my approach to it, like I’m keen to- to use it more, and I feel, um, that since using it this year, it’s led onto other ideas for next year. (AP2)

I think we are in particularly trying to encourage more peer review, peer assessment and feedback within the class. So we think that’s an important tool, so that was quite good just let them generate a class discussion on plans that were out, and beam arrangements they thought were appropriate or not, and hearing each others’ ideas. (AP1)
3.2.5.2 Where to from here for individuals?

Whilst all participants acknowledged there was need for a different approach to integrating VERT, particular mention should be made of the reflections from the individual tasked with taking a lead in the departmental integration of the system. This role was not given to an individual with more experience or training in VERT, rather someone who was willing to take the task on. Whilst it was recognised that some form of support for developing VERT use needed to be provided internally, the onus remained with individual members of staff to clearly identify the teaching and learning goals they were considering using VERT to meet. A collective approach to successful integration of the system into the curriculum was required in the eyes of all participants. That would only happen however, if a collective understanding of the system and its abilities is developed. The participant held the view such understanding is not possible unless each member of staff wishing to use the system takes some ownership for actualising that aspiration. The experiences with the planning components of the BRT programme demonstrated this was necessary and interestingly aligned with the teaching culture which prevails in the department as whole.

I think I have to go explicitly to people, and get very clear ideas about- not just how they think they want to use it, but the timing for when that might be, and an actual plan of what the outcome is they want from it. I think there’s been a lot of ‘yay’, yes, I want to use this, I want to do it,’ but trying to pin people down to exactly what that might be and how it might look and what value it’s adding to their class, I will need to drive that far more. (AP3)

I would like it to be embedded enough that the staff were able to at least deliver the content themselves, and that- have the skills that are basic presentation set up, and that they can refine, alter, as need be for that. Um, I’m still not keen…… of being the person who creates the entire module, and then hands it’s to someone else, who just delivers what’s on that virtual presentation, I don’t like that. Personally. I don’t think it’s how we work, it’s not a model that we’ve had teaching, here, we’re very much this is your paper, you create your, and you deliver your- your module, your- your paper. Doesn’t mean to say it can’t change, but I just don’t see that that’s where we are. (AP3)

3.2.5.3 Aspirations for the Department

Three key elements concerning future use of VERT emerged as worthy of consideration by the department.

1. Participants indicated their belief that there is a gap between theoretical learning and clinical application which must be bridged.
2. The ability of the system to simulate real life situations, which radiation therapists encounter in clinical practice, provides the opportunity to engage in learning processes which could prepare students for those situations.
3. Practices such as reflective learning and peer learning have been identified elsewhere in this chapter; in this context, such practices are deemed useful in drawing together a broader range of student experiences and learnings from other aspects of the programme.

_These students actually spend a lot of this course clinically. They do clinical application. A lot of the time. I think there’s a lot of theory we still have to get across.......there is that balance of theory, and clinical application, and I think VERT is the bridge of where we can really demonstrate and talk about here._ (AP3)

_Um, certainly it makes it a little bit more real, than someone just standing at the front ‘well, you know, patient’s said ‘I’ve got nausea’, what are you going to do?’_ (AP2)

_And it’s another tool to be able to, um, encourage that reflection, it’s a different way to do that reflection. Um, you know, it could be done one on one, could be done in that group environment, could be part of a peer assessment, as well, I mean it lends itself very nicely to those kinds of- not so much the one on one, but the group, and the peer assessment, and the- the- the reflection on ‘okay, I’ve done this, but I could have done that,’_(AP1)

Participants indicated that historically, radiation therapy is not a profession with a well-established research culture. Participants identified that they need to consider their teaching practice on an ongoing basis and how it can be developed. It was suggested that as there were already efforts by the department to develop the use of VERT and there was a need to develop platforms for academic research, it was worth considering bringing the two together. Like the implementation of VERT itself, some direction and coherent planning would be needed to ensure success.

_PARTICIPANT:  Um, well I mean I think- I think we have departmental buy in, I mean I think everyone sees it’s value. I think as a, um, as a department certainly we need to look at it as a research platform, as well as a teaching platform, as well. So I think in terms of departmental research, there’s individual and then bigger group stuff that could most certainly be happening, as well._

.INTERVIEWER:  Okay. Does that need a master plan?

_PARTICIPANT: Yes, like everything it needs a master plan._ (AP3)

The curriculum which forms the BRT was first delivered in 2009 following an extensive curriculum review process. Participants discussed the likelihood that further review would take place and the potential for the availability of VERT to influence that, or perhaps even, to some extent, direct it. There was awareness demonstrated of developments within programmes outside New Zealand, although this did not necessarily mean those models would be followed. It was deemed likely that VERT would be a significant part of any review process and that this would be a sensible approach for the department as a whole.
I mean you can build your curriculum around VERT, obviously. For me, the jury is out a little bit, on that, still.... I know there are departments who are looking to do that....some of it’s been around clinical skills, which we have a need for before they go out, but our program nature means that our students are out there for six months, they actually consolidate their clinical skills very well, ....... very few students are actually failing on clinical skills........I think VERT was the final piece of the puzzle for some of what we do, already. Do we need to create our curriculum around it? I don’t know currently, however changes are afoot, and it may be that yes, we do look at that. (AP3)
3.3 Clinical Staff Results
Two interviews were conducted with clinical staff who had teaching responsibilities within their respective clinical departments. The question schedule used to initiate discussion for these interviews can be found in Appendix L. The interviews were conducted in December 2013. Quotes from participants are attributed to Clinical Participant 1 or 2 (CP1 or 2).

3.3.1 Motivations and Teaching Philosophy
When questioned as to why they were in their respective roles both participants alluded to being drawn to teaching, enjoying the sharing of knowledge and contributing to the up-skilling of others whether they be students or colleagues. Neither indicated the assumption of their roles as part of any plan in how their career developed, rather a natural development coming from experiences which they enjoyed and found rewarding.

I got drawn to students because I quite enjoy teaching people. (CP1)

I like to sort of share knowledge, and you know feel really good doing that, so it sort of came naturally that I, you know, put my hand up and was happy to do the supervision of students in the planning are. (CP2)

With regards to their overall approach to teaching and learning, both participants reported similar influences. Neither reported possessing formal teaching qualifications although one had attended a clinical teaching course. Both participants reported a teaching philosophy based on strong links to their own experiences as students, good as well as bad. Participants indicated determination to repeat those learning experiences they found useful and avoid those which were not. These experiences combined with a very strong sense from both participants that the clinical practise of a radiation therapist is very much based on a practical skillset. Subsequently the reflections they indicated around their teaching practice placed significant emphasis on kinaesthetic approaches to learning for example the modelling of good practice which students would be expected to follow.

as a student I remember occasions just being told a concept, especially in planning, I hated planning, back in the day, and here I am now, you know- a specialist planner. (CP2)

And so I wasn’t able to get it, and that held me back in terms of reaching my, you know, objective, because I didn’t understand that concept. (CP2)

Monkey see, monkey do. If you don’t want your students to do it, then really you shouldn’t be doing it to start with. (CP1)

Both participants indicated their understanding of VERT was based on demonstrations of the system. In one case at a professional conference, the other was present at a demonstration at University of Otago Wellington for all clinical tutors attached to the BRT. The university demonstration allowed for
some, albeit limited, hands-on use of the system. In both cases the demonstrations were aimed at showcasing the capabilities of the VERT system and as practicing radiation therapists in teaching roles they would have been very familiar with the concepts involved. Both participants indicated that based on what they knew, they perceived VERT’s potential uses went beyond a simple simulation of a linear accelerator’s movements or how patients are positioned in relation to the machinery. Instead their understanding was that the system had the ability to visualise events or concepts which are difficult to otherwise describe or convey. At an early point in the respective discussions both participants encapsulated this by focusing on the system’s ability to promote three dimensional spatial awareness.

> also the ability to sort of have that spatial perception of what’s going on, so um, you know, being able to take the skin off a patient, actually look at the PTV, and where that’s sitting, and that sort of thing, you know, see- actually visualise what is happening, when we’re treating a patient. (CP1)

### 3.3.2 Main Themes

Analysis highlighted two key themes emerging from these interviews:

1. Having a VERT installation provided the potential to respond to the learning needs of the profession.
2. Having a VERT installation mirrored what they viewed as other positive progressions made by the university department as the national education provider.

When considered together the two ideas suggested these clinical staff see VERT, in part at least, as providing the tools needed to bridge a perceived gap between academic learning and clinical practice.

#### 3.3.2.1 Respond to the Learning Needs of the Profession

Both participants saw the use of VERT-based teaching resulting in a useful learning tool for students trying to fully grasp the concepts key to radiation therapy. From the participant’s perspective the role of a radiation therapist continues to develop in terms of the complexity of technology and techniques available. Such development highlights the imperative for students to firmly grasp not simply what they are being asked to do but also why. If the course curriculum and supporting technology were to encourage teaching and learning which promotes a deeper understanding of concepts rather than a rigid following of process, then a more adaptable workforce is generated. The participants indicated this had already been evidenced in the academic department with the use of a clinical treatment planning system as a standard teaching tool for some time. The lack of
concern around using a particular type of planning system is noteworthy, this was not deemed to
disadvantage those going to work in centres using alternatives. Instead, the emphasis was placed on
that deep understanding of concepts which could then be applied irrespective of which tool was
used to do so, as the following will illustrate:

I can liken that- from my experience of learning IMRT.......Where I've done all my training in
3D conformal planning, have all of those concepts, and now, having to learn IMRT, VMAT,
that sort of thing, and for me, I actually had to seek outside- I mean I went and did a post-
grad paper in IMRT to really understand what it was. So have that sort of basic
understanding of the concepts. And then just getting stuck in. And- and practicing, and
doing, with the help of, you know, and support of, um, of my colleagues. (CP1)

Nowadays they come in and they say 'I want to contour, I want to place this, I want to do
that.’ It’s just a matter of finding the buttons for it. (CP2)

Participants indicated having VERT technology available to clinical departments could have
significant impact. They reported a growing tendency for specialisation within the profession,
specialist planners in particular. They indicated this often results in colleagues not being fully
conversant with each other’s responsibilities or roles. Students are often identified as being task
orientated in their efforts to complete assessments. However, qualified staff can also fall into the
trap of silo-ing the components of the workload carried out by an entire department. Having a VERT
system available to qualified staff would permit them to make connections between the various
work flows within any RT department. They felt such a holistic understanding of work flow would
lead to improved practice. They also saw that having a system like VERT would permit qualified staff
to keep pace with developments, allowing clinical practice to maintain forward momentum. There
was mention of the concept a more adaptable workforce as a result:

I don’t think it would just be for students, it certainly would be.......a department-wide tool.
(CP2)

Let’s take you know, an RT who hasn’t seen a VMAT plan, or an IMRT plan. They don’t
understand the steep drop-off of dose from PTV to critical structure right next to PTV. And
what we’re planning to. And they basing, you know, some decisions, off their experience,
which was a huge margin, and you know, a different sort of way of thinking, so that their,
um, when they’re trying to apply planning, it’s based on when they were a student. Not
what’s currently happening. (CP1)

I agree that definitely with the specialisation in- in planning, and also treatment, um, we do
lose a lot of those skills, um, throughout the department so, yeah, and I guess it would
improve the ability to think of all areas as opposed to each area in isolation. (CP1)
3.3.2.2  Progress made by the academic sector

Participants seemed generally positive that the direction being taken by the academic department for the BRT was the right one. The radiation therapy profession has changed what its members are expected to be able to do, so the expectations and requirements for a beginning practitioner have also changed. There was acknowledgement that the development of the curriculum and how it was delivered were contributing to students progressing though the programme successfully and meeting radiation therapy workforce needs. Some specific examples were cited, such as the ability to adapt a plan to the realities of variation within the patient on a given day. The perception seemed to be that obtaining VERT was a step in the right direction and consistent with the type of improvements they had seen over their time in the profession. The perceived gap appeared to be narrowing. The following comments will illustrate:

_I definitely think there’s been a change, in the last three years since I first started doing clinical tutor. Um, you know, IMRT/VMAT was not mentioned, two or three years ago. Um, whereas we’ve been doing- clinically we’ve been doing it for four and a half years. So it’s- it’s nice to know that nowadays, the students come in and they understand what IMRT/VMAT is, and that that’s kind of the way that we’re heading._ (CP2)

_Certainly there was a huge gap between things at university and being on clinical. Certainly that bridge is getting smaller now, but ultimately, having VERT would also even further bridge that as well._ (CP2)

Perceived gap between theory and practice

It is worth drawing out what both participants described as a gap which exists between theory and clinical practice. This was in part due to one of the issues raised above, that there had been differences in the way things were taught within the university environment and clinical reality. However with positive action to address this, the issue was now perceived to be more around difficulties in transitioning from learning new theory to being able to apply that theory in the clinical setting. Some of the challenges to this transition were found in limitations to clinical access and getting the necessary clinical experience, some were more abstract. VERT was viewed as having the potential to close the gap:

_They don’t really get to see a patient and things when they’re at university, so when they come into the clinical, there’s a big machine standing in front of them with all different controls and things, and then a patient lies down, and I can- I can see a difficulty between translating from- from seeing something in a planning computer, to try and then translate it on to a patient, and get the 3D concepts around that idea. (They’re) hoping that- that with VERT, that that would improve._ (CP1)
And, I almost see them coming in with a greater understanding of what's going to happen in the clinical setting, and they'll have a different sort of foundation I guess, to where they're coming in from. (CP2)
3.4 Results from the Inventor

An opportunity arose to conduct an interview with one of the three original developers of the VERT system. The interview was conducted on a semi-structured basis and the brief schedule used to prompt discussion can be viewed in chapter 2. The interview was conducted in late November 2013.

When asked to characterise the intent or motivation giving rise to the original idea which became VERT, the participant described a history of being frustrated with the inability of existing tools to help explain concepts being taught to students. The “easy solution” would have been to bring students into a bunker and demonstrate with the equipment (Linear Accelerators) the ideas being addressed. In the context of the English healthcare system this was problematic at best as machine time was and remains a precious resource and priority had to be given to the treatment of patients. The problem remained however of adequately meeting the teaching and learning requirements that existed.

...well I particularly was doing a lot of teaching at (TOWN), and figured that you came to the same sort of sticking points every year, when you really wanted to walk into a bunker. But wasn’t possible because of the scheduling, and all the usual things that we cite.............So I started looking at ideas of could we get some better teaching materials.

From the subsequent conversation three main themes emerged which can be described as the following:

- Motivators for Development
- Success and Frustration
- A Possible Shift in Teaching Paradigm

3.4.1 Motivators for Development

As previously alluded to, original intent was very much based on a local need, the development of a teaching tool which would provide alternatives to limited access to real life equipment. The students could not readily access a LINAC (LINear ACcelerator), therefore the LINAC must “come to the students”:

the general idea to start with, or the principle, was to make a LINAC available to people in a classroom whilst they’re being taught, so that you could either teach with it, or dip in and out of its use whilst you’re talking about other stuff.

It does not appear that the developers’ primary driver was to engage in a commercial exercise or become the directors of a company which would produce and market a commercial product. Rather, it would seem they wished to improve their ability to teach students by developing a means of introducing challenging concepts and ideas and provide meaningful learning. In keeping with this
academic thinking, they sought to fund a resource-hungry project by establishing a collaborative research group with other academic institutions. Completion of a research project would, in their minds, provide an evidence base that their idea was worth pursuing. There seemed to be conviction that the educational merits of the idea would overcome any issues encountered. If anything, a successful outcome would go much further than providing a simple alternative to visiting a physical LINAC bunker but many more options for teaching and learning would emerge.

the core role is to provide better education tools, or a better education environment for radiotherapy

So we actually came up with a concept which was quite innovative, I think, of to raise money to get the system developed......we looked for four partners who would buy a research agreement for two years, so, they weren’t buying the system, they were buying a research collaboration

it always to me seemed like a good idea, and I couldn’t understand why it wouldn’t work.

...became very apparent that there were lots of things that you could then show, or demonstrate, or use it in your explanations, that wouldn’t be possible in a regular bunker anyway.

3.4.2 Success and frustration
Whilst producing a stable, working VERT system was indicated as a significant achievement for those involved, it was acknowledged that the commercial success of the system is owed in some part to how it was perceived by unrelated outside parties. Whilst the developers followed their academic approach and envisaged a period of development and evaluation lasting some years, the transition from prototype to VERT being widely used was shortened by those who saw potential benefits for the system on a more political level. Mention was made that the climate in the UK Healthcare system at the time was one of significant upheaval. A government taskforce had been appointed to examine the provision of cancer care services including radiation therapy. One of the challenges facing the delivery of such a service was the recruitment, training and retention of qualified staff to do so. Some who were providing expert advice to the taskforce were aware of the VERT prototype and perceived that there was the potential for such a system to feed into the training and retention of roles where there were shortfalls. It was believed that the relief brought to pressurised clinical services by a simulation training system, could be felt across England with universal uptake of the system. Indications were that Higher Education Institutions (those providing academic training) and the clinical centres where clinical training took place would all benefit. In a relatively short time a
collaborative research exercise between 4 organisations escalated to a national rollout of the system requiring 50 installations funded by central government.

we wanted it to be two years because we wanted to do some academic study, on it, and show some benefit ........ Um, and so we figured two years was necessary for that, and we would get it published

NRAG is the national radio therapy advisory group. I was on the technical committee....but there was a work force stream that I wasn’t involved with, who, unbeknown to me, had been monitoring through [NAME], what we were doing, and she had been feeding to him. They then started coming to visit us, then, um, then [NAME], himself, wanted to come, and I think that day he pretty much made his mind up that he was- well he- he was recommending that the department of health purchase some of these systems

I thought we’d sell two systems......Then, [NAME] helped me change my perception by coming and saying he wanted ten large systems and forty hospital systems.

This success was reported as welcome and the multi-site installation provided a great deal of evidence for the demonstrable benefits of the system in the eyes of the participant. However these benefits were not necessarily those hoped for by the people instrumental in the initial commercial success of the VERT system. The participant held the view not all sites with a system in situ were enjoying its full potential, nor were they invested in exploring such potential. Also of note was, for such a large project affecting all of England, it was somewhat unique in being completed on time and within budget. The participant also reported that despite the successful roll out of 50 installations, the anticipated benefits to the training and retention of qualified staff were not as clear cut as those to undergraduate students or other trainees.

And I think we have a residual challenge left over that a few of the systems are still not being used as much as they- well as I would like them to, or as much as they should be, because they haven’t had, ah, a champion to really drive it, because they never really got it in the first place.

Well it wasn’t our intent.... the mechanism for being able to affect attrition would be to give people more access to hands-on experience during the training, which is one of the things that was cited. Although, personally, I still think that the biggest cause for attrition is- is financial, and people just not being able to cope with carrying on with the training.

It was reported as an ongoing frustration that some centres did not seem able to exploit the potential of the system. This was attributed to a number of reasons, chiefly the lack of investment on the part of many centres to develop use of VERT to suit their own context. As previously indicated much of the impetus to obtain a system came from central bodies rather than local sites. It was
reported that something so novel was unlikely to gain traction or significant use if some “cost” had not been required to obtain the VERT in the first place. The participant indicated this lack of development was more likely to be symptomatic of a wider culture of slow adaption or resistance to change found in the healthcare system as opposed to a prevailing attitude to the VERT system per se. There was acknowledgement that whilst VERT presented potential solutions the system was by no means a panacea to the issues found in delivering healthcare. The following comments will demonstrate these ideas:

*But, it’s- it’s always been broader than just being able to drive the couch up, and rotate the gantry, I mean that’s just- that’s the basic stuff*

*If we just dwell on the centres that are not using it as much as we would like... I think the main reason for that is- is resources, and a general resource problem in that department, maybe a lack of somebody to really sit down and think- or the lack of having somebody who can sit down and think how to do things differently.*

*they’re leaving a- individual departments cause they’re not getting the opportunity to develop themselves and things like that. And VERT certainly gives you the opportunity to do that. Um, but then probably the underlying problems in those departments is that they’re not allowed the time to do it, the development*

### 3.4.3 A Possible shift in teaching paradigm

Despite reporting some frustrations with how the system has actually been used with particular respect to the English context the participant clearly indicated that the outlook was good for the company building VERT and the continued development of the system as a teaching tool. As more installations came on stream, the original vision as to what it would mean for education and training in radiation therapy was more likely to be realised. Uptake of the system globally has doubled since the original 50 site order in the English setting. This has led to the development of an international user group where various clients with the system whether academic or clinical can come together discuss ideas and contribute to the development of VERT. While its core design and basic intent remains the same, the extent to which the system has permeated radiation therapy education potentially allows software development led by the needs of the client much more than the original inventors of the system. Other disciplines can now take advantage of the educational value to be found and indeed patients undergoing radiation therapy can in some instances benefit from the system’s ability to visually present difficult concepts.
the- the Canadians will- will wax lyrically for hours about how they’re using it, and the Americans are just- think it’s- you know, it’s absolutely changed the way they- they train people now.

we want it to be picked up and- and engaged with the sort of CPD community.....and of course we’ve introduced the physics tours, and part of the reasoning there was to make it- to broadened its appeal to other professionals. And we’ve got the PEARL products......but say that the PEARL product is really aimed at the oncologist, and the patient can even see that, so that it- to help them in their consultations and discussions and the treatment that you can give the patients a better understanding of- of the basic process

(Note: PEARL is a simplified version of VERT designed for doctor/patient interactions. It is also designed to run on desktop computers)

Particularly interesting from an educational perspective is that the participant indicated a novel approach to learning is possible when the system is fully utilised. No claim was made that a new theory of learning has been invented with the development of VERT. Rather VERT is a tool which more readily meets the needs of how teaching and learning has been evolving in recent times. Radiation therapy is a technology driven speciality within medicine and that technology depends on an increasingly higher level of automation, the participant indicated that given this context the system could therefore be considered a “product of the times”. The increasing automation in radiation therapy means potentially less understanding of the theory and concepts underpinning the discipline on the part of practitioners. The system, in his estimation, allows a depth of understanding that more traditional teaching techniques would struggle to provide as effectively. The novelty of the technology was also perceived to be of value, representing a less imposing and more engaging way to learn. There was some indication that these factors combined in allowing student and qualified practitioners to learn in a fashion and at a pace which would not only take individual student needs into account but also make accessible, technology and techniques which might otherwise be avoided because of their complexity. The participant indicated this change would perhaps see the issues around attrition in the relevant professional groupings being more effectively addressed.

I think what we’re seeing is that the use of VERT is developing, not just because we’ve provided them with VERT, but because the whole of the educational approach is changing, world-wide ...... And, so, everybody’s looking for sort of more practical, hands-on, interactive, get people excited stuff.
Every system’s becoming heavily dependent on computerisation, and automation. And I think that that just means that it’s even more important that people have a thorough understanding about what the system’s doing.

(THEY) don’t understand IMRT, so we need a better way of trying to explain it.....we’ve got to that point where people either did understand it and just were too apathetic to do it, so they needed a different kind of a push, to do it. Part of it was understanding the benefit. And the other class of people just still didn’t get it, so there was no point just sending them to the same bloody course again, you had to put it across in a different way.

When questioned, the participant did see an influence on how curricula are designed and delivered now that the VERT system is available to the market. The subsequent impact on teaching and learning was very much dependent on how the system was utilised. That utilisation was very much dependent on how well the abilities of the VERT system were understood. It was clear that in his mind the system represented a means and not an end in itself. He acknowledged that commercial success was important if the system was to be supported long term and continue to be developed. That said the commercial success was to his mind secondary to the growing contribution to the continuing improvement and development of the education of radiation therapists and associated professions.

coming back to your question, are we going to force people to change, I think in some sense we might claim that we are, but- but that’s because we provided them the tools to be able to do it...... Well, maybe we need to look at a different way of teaching (radiation therapists) making it more interesting, or better retention, whatever.

the biggest buzz I’ve got out of this is we’ve changed the way English radiographers are trained. Every radiographer now, that’s been trained over the last five years, has used VERT. So that’s quite an achievement I think.

3.5 Summary
This chapter has reported the analysis of the survey and interview data collected from the four groups of participants in the study. The main ideas and themes highlighted by that analysis have been included and provide the basis for the discussion chapter which follows.
Chapter 4: Discussion

The main aim of this study was to:

“Investigate the integration of the VERT virtual reality system in the teaching and learning associated with radiation therapy planning skills, as a component of an undergraduate radiation therapy programme.”

This chapter is a discussion around the results described in Chapter 3. Rather than simply referring to the aims and objectives which were determined at the beginning of the study, the chapter is organised into sections each of which deals to the key learnings from the study. In this way the data and subsequent ideas to emerge from the study are what are reflected in the discussion.

The chapter closes by briefly outlining a series of recommendations which have been developed after consideration of the key learnings discussed.

4.1 Has there been an impact?
The title of this thesis is:

“The impact of the VERT virtual reality system on teaching and learning associated with radiation therapy planning skills in the second year of the Bachelor of Radiation Therapy.”

The Department of Radiation Therapy lobbied intensively for almost four years to obtain the Virtual Environment Radiotherapy Training or VERT system. Thus high expectations were generated from: within the department, the various individuals and bodies involved in the lobbying process and finally the funding providers, who quite naturally had their own expectations. This atmosphere of ‘what might be’ was referred to explicitly by student and staff participants alike. For example, the formal launch of the system involved the Minister of Health for New Zealand and associated dignitaries which drew significant press attention. In addition the department uses VERT as a tool to promote its role to a variety of organisations and individuals.
4.2 The impact on the teaching environment

Structural changes were made to the buildings that comprise the department prior to and since the system was installed. In addition to installation, a significant schedule of building works was conducted in the teaching, storage and office spaces which form the Department of Radiation Therapy. This work created a suitable environment for VERT, its associated equipment and ensured teaching space was not compromised. Existing equipment was redistributed and other space was reconfigured into staff offices and storage facilities. Even the male toilet facility underwent significant remodelling.

The teaching timetable has changed; with the availability of VERT, staff sought opportunities to use the system in their teaching. Such adaptions in the timetable have not as yet resulted in other facets of the course seeing a reduction in time or resource set aside for them. There is no evidence yet to suggest that the advent of VERT within the BRT at Otago University has replaced any other resource or teaching.

The changes produced varying degrees of frustration for both staff and students for different reasons. For instance, students consider they are not getting enough exposure to VERT. Staff, on the other hand are not getting to grips with the system as well or as quickly as they would like. There is however significant evidence of reflection how to move forward with using the system. It could be argued this is something staff are expected to do anyway and is indicative of good teaching practice. However, it is noteworthy that students demonstrated similar reflection as well. The student cohort took advantage of the opportunity to voice their ideas and concerns and many of their comments are negative. On balance, once they had opportunity to give vent to their concerns and issues they did provide constructive ideas concerning how they foresaw the VERT system working to their advantage. Staff have had a challenging first year as they had to make the transition from lobbying for a resource to putting that resource to effective educational use. The results indicate this has not been a smooth transition but a learning process has taken place and in common with the students, teaching staff have spent time reflecting on how to best use what they have learned for future use of the VERT system.

Despite their limited exposure to the system it is also interesting that clinical staff who participated saw that VERT had strong potential. They characterised this as maintaining significant momentum already gained by the university when preparing the students for clinical placement and meeting the developing teaching and training needs of the radiation therapy profession.
4.3 VERT: Just another piece of Information technology?

It is of no great surprise that VERT has had an impact but that impact has not been universally positive. The central component of VERT is a piece of software whose sophistication lies in making links between pieces of hardware manufactured with very different design goals; for example a control panel for a complex medical device and a high-end data projector. It is something of a reductionist view but for the sake of argument the system could be described as ‘just another IT product’. It is natural then that its implementation has been marked with challenges and barriers. An overview of IT projects in any context will easily find examples which have challenged the most resolute of project managers. This is not a new phenomenon. Almost 15 years ago some of the issues surrounding the introduction of IT into the educational setting were described by Watson (Watson, 2001). The most basic of these was the question; ‘Is IT actually a topic in its own right, with underpinning concepts and ideas, or simply a tool whose purpose is to support the learning of other topics?’ The issues around successfully introducing technology into the classroom are well documented, to the extent that efforts have been made to come up with a systematic approach to overcome them (Groff & Mouza, 2008). That aside, the main thrust of Watson’s discussion concerning IT in education, was a genuine desire to have the latest and newest technology is no guarantee of the best impact for staff and students (2001). It is worth noting that the inventor of VERT described it as:

_The only successful IT project in the entire English health care system_

He defined success as delivering what was promised, when it was promised (the promise being a number of functional VERT installations). If this is the definition to be used then VERT has indeed been successful. This study has indicated however that installing the system is a logistical exercise and educational success in terms of integration or achievement of learning outcomes is much more complex to assess.
4.4 Simulation and VERT
As the examination of related literature in Chapter 1 demonstrated, there are many versions of what constitutes simulation in the context of educating health professionals (Bray et al., 2009; Cant & Cooper, 2010; Kunkler, 2006; McGaghie et al., 2010). This can range from low to high fidelity simulations and the method of delivering the simulation can vary the impact and potentially what can be learned by their use. For example, the contrast between what is considered an immersive simulation like VERT and the web based Otago Virtual Hospital developed by the Dunedin School of Medicine at Otago University (Blyth et al., 2010). The latter is a tool which provides trainee doctors with clinical problem-solving scenarios via a web based platform and interaction with the tool is via a ‘chat’ or text based interface. The variation in understanding of what is simulation was reflected within the group of participants in this study. Some of the participants described using a radiation therapy treatment planning system as a kind of simulation. Although not all participants agreed with that view initially, they did stress the caveat that the definition used was important. The author has determined the following as the definition of simulation for this study:

“Something representative of real life scenarios or objects or complete environments where all salient factors are controlled such that the consequences of making mistakes are not serious so far as patients are concerned.”

Specifically in relation to this study two elements of the definition considered most important are:

1. The control of all factors which influence any scenario outcome.
2. The removal of significant consequence in the event mistakes are made.

As the use of a simulation like VERT can be described as experiential it would seem appropriate to consider Kolb’s theories around learning. In his book Experiential Learning (Kolb, 1984), Kolb describes learning as a process not an outcome and one which is constantly revised as experience is ongoing. Making that assumption, providing students with ongoing opportunities for learning experiences which can be simplified or broken down can help students interpret what they are learning from specific experiences. In order to build confidence in such new learning, it is arguably useful to control exposure to new experiences for students or at the very least allow them to understand which tasks or experiences they are undertaking. It has been reported that simulation permits a teaching environment where experiences can be repeated which improves performance (Reilly & Spratt, 2007). Such control or repetition is not to be found in the clinical setting.

Experiencing adverse events and reflecting upon them is often cited as part of the learning process, the creation of what is deemed a safe and productive learning environment allows for and expects
this possibility (Kneebone, 2003; Satava, 2001). Kolb’s ideas of learning by experience in an environment where students can engage in some experimentation or by trial and error are most insightful (1984). From a student perspective, simulation provides opportunities for such learning opportunities to happen (Bray et al., 2009; Phillips et al., 2008). In the simulated context, there is a sense students need to feel they have permission to fail (Good, 2003). Contrast this with the notion that making mistakes in a clinical setting is unacceptable in which it is neither ethical nor moral to seek or permit events which compromise patient safety or well-being (Ziv et al., 2006). As a consequence student learning becomes a consideration secondary to patient health. As Kneebone identified, when a simulation is used, student learning needs are placed firmly in the forefront (2003).

Using the above definition it becomes clear where VERT, as an immersive simulation, fits when compared to other simulation types. Consequentially the use of a clinical treatment planning system in the classroom, controlling the learning environment and removing patient risk can be considered simulation. The department at UOW has such a system known as ECLIPSE. By having such a system available, a teaching simulator already exists. This may well pose the question; ‘Why do we need another one?’

The answer is to found in the following. Teaching staff and students on the BRT have, for different reasons, identified VERT as a flexible tool capable of demonstrating the concepts staff are trying to teach and students are trying to learn. The inventor of VERT indicated his intent was to develop a ‘better’ way to tackle the perennial challenges which arose attempting to explain radiation therapy concepts. Until VERT became available, a number of alternatives had permitted simulating aspects of the radiation therapy workflow outlined in Chapter 1 (Boejen & Grau, 2011). In the context of the University of Otago, the primary tool for simulating clinical concepts and scenarios has been a clinical treatment planning system. Whilst this study in no way indicates using a planning system in this manner is an undesirable situation, there is a major shortcoming in depending completely on a clinical system for teaching purposes. ECLIPSE is a commercially available treatment planning system (“Varian Inc,” 2014). As such ECLIPSE does not include teaching people how to plan radiation therapy in its design brief. Rather ECLIPSE was designed, built and marketed as a system to enable qualified practitioners, already possessing the requisite knowledge and skills, to actually generate those treatment plans.

The previous paragraph underlines what sets the VERT system apart from other solutions for educational simulation in radiation therapy. VERT was designed to visualise all pertinent aspects of radiation therapy workflow; including treatment position determined for a patient, CT data used to
generate a plan, the structures targeted by the plan and how that plan is delivered. Most importantly VERT was designed and built with the specific remit to teach this range of concepts in a more accessible fashion.

Much of the experience of simulation in medical education is based on human patient simulation (Bray et al., 2009; Huang, Reynolds, & Candler, 2007). Simulation is concerned with what the patient does or how a patient might respond to a variety of circumstances or medical interventions. In many cases the simulation is an attempt to give trainee practitioners practice in the skill set needed to conduct such interventions. Examples would include simulators for laparoscopic surgery, anaesthesia, dental surgery, history taking and responses from critically ill patients in trauma centres (Gurusamy et al., 2008; Kunkler, 2006; Littlefield et al., 2003; Stylopoulos & Vosburgh, 2007). The important concept is that motor skills or communication skills are those being taught, not necessarily the concepts underpinning them. Radiation therapists use complex equipment to treat patients and in this respect are not dissimilar to many health disciplines. VERT has been identified as being useful in developing those same motor and communication skills (Boejen & Grau, 2011; Green & Appleyard, 2011). It can be argued that the best possible use of those skills and equipment comes from understanding the concepts which underpin them. This would require effective, deep learning and a programme design designed to promote teaching and learning that facilitates such learning (Biggs & Tang, 2009; Ramsden, 2003). This was certainly the perception of teaching staff who were interviewed, the inventor of the system and interestingly enough the students themselves.
4.5 Frustration

Results from university teaching staff, students and to some extent the supplementary data obtained from the system inventor indicate a common issue. All these participants have expressed some sense of frustration with respect to the level of success integrating VERT into the teaching programme. How this frustration was characterised varied between groups, understandable given the varying perspectives. Student frustration with the lack of exposure they had to the system has been mentioned previously. Also of interest was that students perceived the introduction of an exciting and expensive technology, which was supposed to benefit them, had been overshadowed by the department promoting it success in obtaining VERT. This frustration is understandable. The nature of the BRT means students are under constant pressure to meet exacting standards. As the BRT is a vocational course, some of the perceived advantages of undergraduate life are not available to them. For example long periods of free time in summer vacation months. Under pressure to perform, there can be a tendency to view events which are not directly beneficial as barriers, whether real or imagined. Academic participants commented on the tendency for students to compartmentalise learning and by extension limit their understanding. There is evidence suggesting the Piagetian concept of an egocentric outlook on learning normally associated with early childhood and adolescence is not confined to those stages of development. Frankenberger described work which compared adolescents and adults and demonstrated adults aged 19-30 was not so different to the adolescents with respect to measures of those characteristics (Frankenberger, 2000). The student cohort in the present study fall into the age group described.

The frustration concerning student exposure to VERT was a shared one. Staff expressed dissatisfaction with the experience afforded students and perceived that potential benefit had been missed. There was mutual empathy around the lack of confidence in using the system and how this impacted on opportunities to integrate VERT into teaching situations. Students described staff as displaying variable degrees of comfort and familiarity in using the system but understood this might be the case with any new experience. Students were positive about experiencing new technology and learning approaches, acknowledging this means a learning period for all concerned. Staff reported disparate levels of training explaining the variability in confidence with VERT. None of the training provided was specific for UOW requirements. All users were experiencing the first iterations of using VERT in that context. Staff had heavy workloads, leaving little opportunity for development of learning resources or lesson plans using VERT. While staff wanted to do more, there was tension between their desire to provide the best learning experiences for students and ensuring students completed learning objectives. In some cases the response was to rely on tried and tested teaching methods. Evidence from staff interviews highlights some points of note. VERT was installed less than
a calendar week from the commencement of the teaching year, additionally there is normally little opportunity for teaching staff to conduct course development work outside of the summer break. Part time Professional Practice Fellows have no protected time for this kind of work during the teaching semester. The individuals who fill these roles often do so because of their considerable clinical experience rather than educational training. Bray et al identified comparable issues among other health disciplines attempting to integrate simulation based teaching and described them as barriers to implementation. Two specific items they described were:

1. Inadequate training to use the simulation,
2. Increased workload in integrating simulation into curricula.

These items were of moderate to extreme concern to their respondents in 56% and 43% of cases respectively (2009). McGaghie et al conducted a series of reviews of medical education simulation. Of note with respect to instructor training in their 2003-2009 review was that they identified simulation based education was not ‘easy or intuitive’ nor could clinical experience be used as a proxy for effectiveness as a teacher using simulation based techniques (2010).
4.6 Varying Views of Stakeholders

4.6.1 Students
Whilst staff reflected on a more coherent approach to the process of integrating VERT, there is limited evidence of students being included as stakeholders. The idea of negotiated curriculum is not new and has gained some traction within secondary school systems as well as health disciplines around the world (Brew & Barrie, 1999; Fielding, 2001; Thornton & Chapman, 2000). Its implementation varies with context. The Bachelor of Radiation Therapy (BRT) is a vocational course, with standards established for registration and licence to practice purposes. This will necessarily place limits on what aspects of the curriculum are subject to negotiation but the evidence suggests that such engagement is worth consideration.

The motivation of individual students and staff efforts to engage with them can significantly influence successful learning (Biggs & Tang, 2009). Thus, a student who does not appreciate the benefit or justification of an assessment for example is unlikely to invest much effort in it (Boud & Falchikov, 2006). Arguably the successful engagement of a student or cohort of students leads to increased potential for learning. If such engagement included clear consultation and students perceived that value had been given to their input, potentially they have increased motivated to learn.

4.6.2 Staff
There is little evidence of a departmental strategy to implement VERT into the teaching programme. Subsequently the needs of staff conducting the implementation do not appear to have been well considered. An example would be the lack of focused training in the use of VERT. The training provided by the vendor was intended to be introductory in nature. The assumption was made by the vendor that the client (the university department) would address their own development needs. Staff interviewed acknowledged responsibility lay with them to develop teaching resources using VERT. The existence of full teaching loads and little or no protected time to undertake such tasks made that responsibility difficult to meet. Again the experiences reported by Bray et al around lack of training and increased workload are similar to this particular context (2009).

4.6.3 Seeking direction overseas
Referring to the experiences of other VERT users would appear to be a worthwhile exercise. The idea of doing so was discussed by staff and students alike but some difficulties were identified. As the sole provider of RT education in New Zealand the department at UOW is somewhat isolated in its
own setting. Internationally, Australia and the United Kingdom are traditional regions of cooperation. All the Australian RT education providers have had a VERT installation since 2011. UOW staff have engaged in collaborative discussions with their Australian counterparts but these have been reported as being of limited value. Funding for the Australian installations was provided by the Commonwealth Government Department of Health and Aging (DOHA). The DOHA had significant influence on the implementation objectives of the Australian providers, subsequently their implementation model does not align well with NZ needs (Dantu, 2014). Universities and clinical centres in the UK have had the longest experience of VERT. Staff at UOW determined integrating VERT into the teaching of planning skills as the chief priority. This is in response to planning skills forming a major component of the clinical workload for NZ RTs. This is not the case in the UK therefore the teaching programmes in UK universities place much less emphasis on those skills ("University of Ulster Course Details," 2014). Interview data from the VERT inventor and published work has indicated the perception held by some that the wholesale adoption of VERT in the UK would allow health workforce issues to be addressed (Nisbet & Matthews, 2011). When the UK government made the necessary funding available for centres to purchase VERT this was not as a consequence of pressure or lobbying from the clinical centres. Subsequently those clinical centres were not invested in the development and implementation which teaching simulations require (James & Dumbleton, 2013). Additionally the focus of evaluative work since the English systems were installed has been on the development of students’ basic motor skills not conceptual learning (Appleyard & Coleman, 2008). Time in possession of the system therefore does not necessarily correlate with the level of expertise gained in its use. It would seem therefore that consultation or collaboration with UK users of VERT has limited value. A possible alternative is to look beyond traditional sources of collaboration. VERTUAL Ltd, the company which produces VERT reports a growing number of installations across mainland Europe, Canada and the United States. One example is Aarhus University Hospital in Denmark, one of the original development partners for the VERT prototype. Published work has reported positively on progress in using the system (Boejen & Grau, 2011). No formal links have been reported between UOW and centres such as Aarhus but may be worth pursuing in the future.

4.6.4 Contrast between staff and students
Staff reported receiving student feedback which indicated greater satisfaction with ad hoc use of VERT than staff anticipated. The staff perspective was they felt inadequately prepared; this was not a teaching experience they aspired to and had anticipated more negative feedback. Two possible explanations could be offered for this phenomenon.
The first relates to the nature of the feedback being obtained. Unlike the survey and the focus group discussions for this study, the feedback offered was relatively easy to connect to particular students. The BRT consists of a relatively small cohort of students (30 per year) in a small department. Students build relatively close professional relationships with staff over the course of three years. Students eventually become part of a small, close knit profession, less than 300 people practice as RTs in New Zealand. Anonymity is difficult to achieve in such circumstances. Subsequently what is reported can readily be influenced by a desire to comply or avoid confrontation with those in authority.

The second explanation relates to the idea that students had expressed great frustration with their perceived lack of exposure to VERT. Simply, it may be the case that any opportunity to use the system for their benefit was perceived to be a good one!

Contrasting perspectives can also be found when considering what students regarded as effective use of teaching and learning resource. By definition students are not yet expert. They do not necessarily have the wider view developed from qualified status and a significant period of time in practice. While student input and reflection is worthy of consideration it is difficult to attribute the same weight to such input as one might to the input of well established practitioners. For instance the students took considerable issue with VERT being used to showcase the department as part of its public relations efforts. That stance does not take into account the need for an academic department to command a positive profile. Without such a profile it is difficult to secure resourcing and support. In much the same way that the programme aims to produce a flexible, adaptable, reflective practitioner with the skills of a lifelong learner, the department itself must continue to develop and communicate its capabilities.
4.7 VERT as an integrative tool

Staff identified their involvement in the teaching of topics which underpinned or supplemented the teaching of planning concepts. They further identified their experiences of how the teaching of one topic supports the teaching of another. The idea of a more integrated approach across the curriculum was perceived in a positive light. As a system designed to simulate the radiation therapy environment it would appear sensible that VERT can be a tool to support the provision of such aligned learning experiences. A possible question then is how far this integrated approach should be developed? Participants discussion centred on how VERT best fitted with the topic or topics they were responsible for teaching. This seems to indicate that in practice, teaching has been silo-ed with little evidence of integration. In 2009 the department began delivery of a revised version of the BRT. The curriculum review process involved extensive consultation with a variety of clinical experts and educationalists from radiation therapy and other health science disciplines (Department of Radiation Therapy, 2014). It would appear that the actual delivery of the programme is more fragmented in nature. In answer to the question posed earlier, there seems to be an opportunity to use VERT as a vehicle to reconsider curriculum design AND delivery. The intent of the curriculum is to prepare students to be beginning practitioners, that goal involves a transition process. Perhaps the notion of a transition process should influence not just how we assess the final outcome but also the means of achieving it. It seems counter productive to encourage students to take a holistic approach to their learning yet not reflect that in the delivery of the teaching programme.

A useful model to consider is that of Constructive Alignment described by Biggs and Tang (2009). The model was developed with curriculum in mind, however its structure requires that curriculum, the teaching to deliver curriculum and assessment of outcomes should all be designed with the others in mind. Further reflection on the notion of a beginning practitioner indicates the idea that once qualified; a radiation therapist still has much to learn. Producing graduates with the skills of a lifelong learner is embedded in the curriculum of the BRT. Such skills are included in the profile of a University of Otago graduate (“University of Otago Graduate Profile,” 2014). Boud and Falchikov have written about how teaching learning and assessment can contribute positively to long term learning (2006). Participants in this study have identified the benefit of an integrated teaching approach. The author would suggest VERT represents a tool which can facilitate such an approach. Care much be exercised when exploring this idea. VERT has been rightly identified as a teaching tool and not a teaching system. The use of simulation represents one amongst many teaching techniques demonstrated to be useful in the health disciplines and cannot completely replace all teaching approaches (Berragan, 2011; Gaba, 2004). It is interesting that one of the motivators of the inventor for developing the system was an increasing dependence on technology amongst practitioners. It would be ironic if in a bid to address such a concern that dependence is perpetuated.
4.8 VERT as a catalyst for change in teaching approach

Those participants who were teaching staff reflected a pattern commonly found within the health sciences. Teaching staff in the health disciplines often enter these roles due to their experience or expertise as practitioners NOT because of their skills as trained educators. Generally these individuals will not have any training in teaching or educational theory before they begin teaching. This is not so different to any discipline in the tertiary sector such as; the arts and humanities, pure sciences or engineering. There is a growing trend that teaching staff undergo such training. Tertiary institutions often establish specialist departments which can support novice and experienced teaching staff in a variety of ways. The Higher Education Development Centre at the University of Otago would be a prime example ("HEDC Website," 2014)

Health science educational literature reflects the importance placed on good educational practice on the part of teaching staff. There has also been a shift away from the more didactic teaching paradigms of previous times. It is not enough to be a good practitioner, an understanding of how students learn and the assimilation of good teaching skills are deemed necessary also (Hesketh et al., 2001; Lake, 2004; Parsell & Bligh, 2001; Young, Orlandi, Galichet, & Heussler, 2009)

Unfortunately it is often the case that clinical teachers need to be convinced there is a need for ongoing change (Stalmeijer et al., 2010). A good teacher will reflect on their teaching practice (Brookfield, 1995; Ramsden, 2003). However, reflection by itself is not an accurate predictor of any changes being made in teaching approach. Stalmeijer et al reported that this was the case for their physician/teacher participants. It was only when reflective assessment and written feedback from students that there was much promise of a change in approach (2010). Other work has highlighted even teaching staff with a clear sense of their educational role did not report significant change in their teaching practices resulting from reflection (Audétat et al., 2012). The challenge then is not simply to encourage reflective practice but how to facilitate progression to positive action. Boud and Walker have proposed a learning model which encourages ‘reflection-in-action’, in other words reflection should not be the end itself, rather, one of the means to learning (Boud & Walker, 1990). The model was designed with students in mind, however successful clinical educators remain learners themselves so the model applies equally well (Rose, Best, & McAllister, 1999).

Data relating to the reflections of staff indicated a transition: from an eagerness to get to grips with VERT, to desiring an improved lot for their students by providing a better learning experience by use of the system. What is challenging for the teaching staff is that changes in teaching practice identified by those reflections called for even greater investment of time, energy and resource to fully develop. Gaba warns of the risk in seeing simulation as an ‘add on’ and highlights the
commitment required to fully realise any benefits to be derived from simulation-based education (2004). As mentioned previously, frustration was expressed by staff concerning a lack of time and resources to develop their teaching practice. Staff will undoubtedly need to work with middle and senior management to ensure they are supported in a manner which allows them to achieve what their reflections have indicated are necessary. However, existing evidence suggests that barriers to changing teaching practice can be internal as well as institutional.

4.9 Theory/practice gap: a role for VERT?

Reflection and reflective practice have been mentioned already in this discussion. It is well established that the ability to critically reflect is a skillset needed by health discipline practitioners, educators and students alike (Mann, Gordon, & MacLeod, 2009). Perhaps the key element making this skill necessary is the need to be a lifelong learner (Miflin, Campbell, & Price, 2000). The focus of this study was an aspect of the BRT undergraduate programme. Teaching staff who participated are primarily employed to deliver that programme. Clinical staff interviewed support the delivery. Student participants are focused on what they need to complete the programme. All participants reported the reflection that deeper understanding of concepts is important. The notion of deeper learning being desirable has been well dealt to in educational literature (Biggs & Tang, 2009; Ramsden, 2003). Deeper understanding produces a ‘better’ practitioner in that they can make the wisest choices in the interests of their patients (Nisbet & Matthews, 2011). Helping teach health professionals who could make such choices was one of the aspirations the inventor had in mind when developing VERT. As Ramsden explained, learning how to perform a task does not indicate an ability to link the practice to the underpinning theory (2003). Here enters a perennial challenge to educating health professionals, the gap between theory and practice (Goode, 1998; Nisbet & Matthews, 2011).

There is some debate concerning the existence of such a gap, Gallagher argues it is notional and its acceptance infers there is ‘right and wrong’ to learning (Ousey & Gallagher, 2007). In some respects any attempt to address an educational problem could infer that current practice is ‘wrong’ and what is ‘right’ needs to be identified. The author of this research would argue there is a distinct difference between correcting a ‘wrong’ and attempting to provide an experience which is more appropriate or beneficial. Irrespective of whether the gap between theory and practice is metaphorical explanation or the description of a discrete entity, it is a concept which is widely referred to and discussed. In this study all participants made reference to a gap which they believed existed and could and should be made smaller.
Perhaps a more positive approach would be to see the tension between theory and practice as an opportunity to acknowledge learning can happen (Goode, 1998). The author would further suggest that such tension indicates learning needs to happen. Students are classed as such precisely because they have learning to undertake before they are ready for practice. Completion of the BRT is regarded as preparation to the level of beginning practitioner. The concept of the need to be a lifelong learner has been mentioned previously. Subsequently no practitioner can ever say they have no more to learn. Data from this study has highlighted how commonly held the view that there is a gap between theory (academic learning) and practice (clinical learning) is. What was also of interest was an indication that ‘gaps’ exist within the clinical context, this deviates from the usual spatial separation of theory and practice where theory happens in the classroom and practice on the hospital floor (Ousey & Gallagher, 2007). Current practice within NZ radiation therapy centres has encouraged a distillation of what practicing RTs are expected to understand and as a consequence what roles they can fulfil. The prime example is the emergence of the planning specialist. Their sole focus is on the development of plans with an ever increasing degree of complexity. Treatment staff appear professionally content to have a more stagnant level of learning. They are inclined to follow the instructions which emerge from a planning section without completely understanding the implications or meaning of those instructions. An internal disconnect and lack of understanding between sections of RT workflow has evolved. Nisbett has identified from the UK experience it is possible to successfully execute clinical practice without fully understanding underpinning theory (2011). Clinical staff could see a role for VERT in continuing the development and training of qualified staff. The inventor indicated a strong desire for VERT to be used for professional development. Whilst the latter can be explained as a natural bid to broaden the appeal and therefore customer base for a product, the discussion has already highlighted the data suggesting VERT provides an integrative tool for teaching and learning purposes. Perhaps then the potential for VERT lies not in its ability to close any perceived gap between theory and practice but in its ability to demonstrate there is a link between theory, practice and the ongoing development of both. Learning is neither a linear nor exhaustive process, perhaps by using an integrative teaching and learning tool across both theoretical and practical teaching that can be made clear.

4.10
This concludes the discussion of the results from the study and is followed by the final concluding chapter.
Chapter 5: Recommendations, Reflections and Concluding Remarks

After a final summary of the study, this chapter includes: an outline of recommendations which have emerged, reflection on the strengths and limitations of the project and the author’s concluding remarks.

5.1 Summary of the study
The Department of Radiation Therapy at the University of Otago Wellington is the sole provider of education for Radiation Therapists in New Zealand. As a professional grouping they are responsible for the planning and delivery of radiation treatment to cancer patients. The university department has recently acquired a fully immersive virtual reality simulation system known as VERT. The system is specifically designed to aid the teaching and learning of the complex concepts and techniques utilised by radiation therapy. The preceding chapters have reported on a qualitative study which sought to understand the impact of integrating this teaching tool into a particular aspect of the Bachelor of Radiation Therapy undergraduate programme. There has been significant impact on the teaching environment, both physical and conceptual. Integrating the system into teaching has not been without its challenges for staff and students. VERT does appear to facilitate some revised thinking extending from overall curriculum design to the teaching of specific topics. What is clear is that significant potential around VERT exists and the study has highlighted some areas worthy of further investigation.
5.2 Recommendations
The findings of this study have led to a number of recommendations which have implications at different levels of responsibility and application. These are detailed below.

5.2.1 Recommendations for the Programme
The Bachelor of Radiation Therapy (BRT) in its current form has been implemented since 2009. By many standards a review process for the programme would be considered timely. The study has indicated significant impact on the programme with the installation of the VERT system. There is also evidence that its use could be considered integrative across subject areas. It would seem appropriate then that any review process would have VERT as a significant factor in its deliberations. A specific study may be warranted to ascertain the suitability of VERT as the framework to draw together elements of the programme.

5.2.2 Recommendations for the Department
Whilst the steps undertaken to obtain the VERT system can be applauded there is evidence of no strategic direction in its implementation into the teaching of planning concepts specifically or the programme in general. Those affected by the installation of VERT have been broadly represented in the participants of this study. They have provided their perceptions of its early use in the BRT. There is evidence to suggest that future development of the VERT system and similarly significant projects would be well served by putting in place a coherent strategy with the inclusion of all stakeholders in consultations. This should serve to maximise positive effects and avoid duplication of workload.

This study represents the first steps in fully understanding the impact and potential of this teaching tool in the NZ context. The Department of Radiation Therapy is in the process of developing a research culture (Dept Review 2012). There is a paucity of research conducted around VERT, a system now found in 94 institutions in 15 countries around the globe (VERTUAL website). It would seem sensible therefore to suggest VERT offers a platform to develop not just the BRT but also research concerning radiation therapy education which could impact on practice in NZ and further afield.
5.2.3 Recommendations for the wider research community

Whilst the focus of the system is clearly centred on radiation therapy, there are aspects of this study which can relate to the wider educational community. Health Science disciplines in particular, responsible for training new professionals, should be familiar with the concept of minimising risk and being aware of potential unwanted side effects. It could be argued that many of the challenges and issues identified by the study can be explained by the fact they emerged in the first year of VERT being used in the BRT. That said; it is worth considering that any discipline which wishes to implement a significantly new way of teaching, would be well advised to adequately plan and test any such intervention before full implementation.

5.3 Strengths and Limitations

This study represents the first fully qualitative investigation of the impact of integrating the simulation-based teaching tool known as VERT into an undergraduate curriculum. Data has been obtained from a broad spectrum of sources representing a range of perspectives on a significant intervention. Previously published work has been largely descriptive or focused on the ability of VERT to introduce student practitioners to fundamental clinical skills. The study has provided a useful first step in developing a critical appraisal of the teaching and learning experience VERT may provide to the New Zealand radiation therapy profession.

The study has been conducted over a relatively short period of time. The development of some of the insights and ideas which have emerged will no doubt continue. They do not as yet form part of an ongoing formal investigation. Perhaps a study of a more longitudinal nature involving a more diverse range of students and specific subject areas would provide a deeper understanding than what has been reported here.

Teaching and learning of clinical knowledge and skills are complex areas to investigate. No single study conducted by a single researcher in such a time frame will completely encompass all aspects worthy of attention. It seems natural therefore, that additional qualitative and quantitative investigation is required.
5.4 Concluding Remarks

VERT is an exciting technology. It is however just that, a technology. Statements of its nature notwithstanding, VERT does present an opportunity to rethink how radiation therapy students are taught and how they learn.

The ability to visualise concepts and ideas in the classroom allows educators to consider how they prepare students for that most challenging of environments, clinical practice. The provision of healthcare to a fellow human being is both daunting and rewarding. It would seem any tool which permits the student to learn how to do this with safety for all concerned is worthy of consideration. A number of avenues for future research exist and add to the excitement around the technology. This study has identified how much we have yet to learn.
References


Appendix A

CHART SHOWING ORGANISATION OF DEPTRT AND ITS RELATIONSHIPS WITHIN DIVISION OF HEALTH SCIENCES, UNIVERSITY OF OTAGO

DEPARTMENT OF RADIATION THERAPY
Organisational Chart
Appendix B

Summary of BRT Curriculum Structure
(Drawn from DeptRT Curriculum Document)

5. Timing of the Programme

5.1 Duration of the Course
The Bachelor of Radiation Therapy is a three year full time programme.

5.2 Composition of Each Stage

5.2.1 Stage I
31 weeks attending classes at the Department of Radiation Therapy, University of Otago, Wellington.
2 weeks clinical placement with a clinical provider.

5.2.2 Stage II
1 semester Radiation Therapy Practice with a clinical provider.
1 semester attending classes at the Department of Radiation Therapy, University of Otago, Wellington.

5.2.3 Stage III
1 semester attending classes at the Department of Radiation Therapy, University of Otago, Wellington.
1 semester Clinical Studies with a clinical provider.
6. Structure of the Programme

The programme consists of 4500 notional hours of student learning divided into three stages.

6.1 Stage I

- RADT 111 Anatomy & Imaging
- RADT 112 Cancer Cell Biology
- RADT 113 Health & Human Behaviour
- RADT 114 Healthcare Communication
- RADT 115 Radiation Technology I
- RADT 116 Radiation Therapy and Oncology I
- RADT 117 Radiation Therapy Planning Concepts I

6.2 Stage II

- RADT 211 Radiation Therapy Practice II
- RADT 212 Principles of Research
- RADT 213 Advanced Healthcare Communications
- RADT 214 Radiation Technology II
- RADT 215 Radiation Therapy and Oncology II
- RADT 216 Radiation Therapy Planning Concepts II

6.3 Stage III

- RADT 311 Radiation Therapy Practice III
- RADT 312 Literature Analysis
- RADT 313 Professional Development
- RADT 314 Radiation Therapy and Oncology III
- RADT 315 Radiation Therapy Planning Concepts III
Appendix C
What a Radiation Therapist Does

It should be pointed out that this appendix aims to outline the model utilised in New Zealand. Other jurisdictions have comparable models; others are subject to distinct variations from that detailed below.

As indicated, radiation therapy is considered a main treatment modality in the treatment of cancer. An exploration of this idea reveals that not all cancers respond to radiation therapy equally but across the range of possible cancers a significant number will. Generally, patients who have received a diagnosis of a cancer known to respond to radiation will be referred to a Radiation Oncologist, a medical doctor who specialises in the use of radiation for the treatment of cancer. This specialist will have overall responsibility for the management of the patient’s condition and will determine; which anatomical structures require treatment, the total dose of radiation used for the treatment and the period of time over which this dose is delivered. This is known as the treatment prescription. At this point the involvement of the Radiation Therapist (RT) begins. Having been given the parameters for the intention of treatment it is the role of the RT to; recommend the best way for the course of treatment to happen, plan how this will be performed and actually deliver the course of treatment over the period of time determined by the supervising specialist.

Subject to organisational variations this clinical workflow is divided into three main sections within most if not all departments within New Zealand, the specific phrases or titles they have will also vary but for the purposes of this description we shall call them pre-planning, planning and treatment.

Pre-Planning

In this section of workflow, patients undergo much of the preparation which is required for them to undergo a course of treatment. This will be tailored to suit individual needs but for the most part will include the following:

- A briefing by the RTs as to what lies ahead and an opportunity for patients to ask questions. To perform this task RTs must have a clear understanding of what does lie ahead for the patient and be able to answer any queries clearly, in a lay-person’s terminology and in a professional manner.
- Decisions are made around the positioning and immobilisation of the patient for treatment. Beginning with pre-determined protocols, RT staff will determine the best way to position an individual patient in relation to the treatment equipment. What constitutes the “best way” is a position which can be replicated on a daily basis easily; means the patients is
immobilised effectively to minimise movement away from this position; one that can be sustained by the patient for the length of time necessary for an individual treatment to be delivered and one which permits the most effective delivery of a dose of radiation to the area being treated. Numerous data and measurements are recorded which will allow staff in the treatment section to reproduce this positioning every day.

- A CT scan of the area of the body to be treated is performed. This scan, along with reports from any surgery, pathology reports or other diagnostic test results will be used by the oncologist to make some of their decisions about the treatment prescription. RTs in the planning section use the CT scan to develop a plan for the best way to deliver the required dose of radiation to the anatomical area of interest.

- Completion of any additional measurements to accompany the CT scan data. As a quality assurance exercise additional physical measurements are often recorded which can be used to verify data obtained from the CT scan. For example measurements with regard to the patient’s physical characteristics.

- Tattooing and mark up of the patient. To permit treatment staff to accurately deliver treatment each day the course occurs over, there are physical marks placed on the patient’s skin. These are used with the aid of positioning equipment in a treatment room to correctly align the patient in relation to the treatment equipment. These markings can be simple pen marks but will usually include a number of reference points which are permanently tattooed into the patient’s skin. Tattoos are very unobtrusive, many practicing RTs have tattoos applied to a hand or forearm so that they can reassure patients of this (see Figure C.1). In the head, neck and facial areas the need for tattoos is obviated by the use of an immobilisation shell. These shells perform the dual task of immobilising the patient and providing a location to place all positioning markings. (see Figure C.2)
Figure C.1: Sample of tattoo used for radiation therapy setup on RT’s arm

Figure C.2: Immobilisation shell (www.orfit.com)

Planning
This section of clinical workflow is widely accepted as being the culmination of all the theoretical underpinning which goes into the training and education of a practicing RT. The basic principle is that once produced, a beam of radiation will interact with whatever medium it encounters in its path. In this context, human tissue such as; skin, muscle, bone, connective, neurological and epithelial tissue. The outcome of that interaction will depend on a number of factors; the energy which the radiation beam possesses initially, how much tissue there is in the path of the beam, how far away from the source of the beam that tissue is, the specific type of tissue the beam interacts with and the length of time the interaction takes place over. This outcome is what is known as dose. In other words, dose indicates a transference of energy. Like most organic materials there is a relationship between the dose deposited and the type and extent of the response of the human tissue concerned. The response is because of the production of free radicals within the tissue resulting from the interaction of radiation with the biological structures. These free radicals damage the DNA of the cells making up the tissue. Given sufficient amounts of damage a point is reached where it is impossible to repair and the cell subsequently dies, or at the very least is rendered incapable of reproducing (the process known as mitosis). This response will happen to any type of cell, whether normal or malignant (the type found in cancers). The cells making up a cancer are often particularly sensitive to this type of damage and in addition tend to be poorer at repairing themselves from the damage caused by free radical production. Normal cells by comparison, whilst still susceptible to damage, are much better at the repair process and therefore stand a better chance of recovery. These principles form the basis of the science known as radiobiology, the understanding of how ionising radiation interacts with biological material.

Developing this principle, if a beam of radiation were directed at a patient in such a way so as to maximise the dose (energy transferred) to the area which is cancerous and minimise the dose to what is apparently normal tissue a therapeutic benefit can be derived. By maximising dose to the cancer and minimising dose to normal tissue greater therapeutic benefit can be derived. This benefit has a number of ways in which it can be measured. The most significant is the potential to kill the cells making up the tumour whilst leaving enough normal cells alive that the patient can make a full recovery and live disease free. As normal tissue can be and is damaged, the treatment has side effects, signs and symptoms of damage which disrupt normal function, these can be short term and transitory (acute) or occur in the long term and become persistent (chronic). Radiation induced side effects depend on the bodily region being treated but can include; skin reactions, nausea, vomiting, diarrhoea, hair loss, pneumonitis, cystitis and neurological dysfunction. Patient quality of life both during and after treatment can be significantly improved if dose to normal tissue can be minimised and thereby minimise side effects. At times, a cancer has advanced to such an extent that a cure is
neither likely nor is it actively pursued. However radiation therapy still has a role to play in alleviating some of the symptoms and dysfunction which may be caused by the advancing cancer. The intent in such cases is to improve the quality of a patient's remaining life, a process known as palliation. The balance to achieve a therapeutic benefit can be even more difficult to reach in these cases. Many individuals can tolerate severe reactions and the resulting discomfort if a cure is intended, this is not the case in such scenarios.

The reader has been provided with the essential concepts which are collectively known as treatment planning. With these concepts in mind, a practicing RT must develop a way to deliver the required dose of radiation to the targeted tissue (the tumour) whilst keeping to a minimum, the dose received by normal tissue. A range of techniques and equipment are available to choose from. There are tried and tested protocols to use as a starting point. However, each patient is an individual, as is their cancer, so while templates and protocols can be used, each patient requires a fully customised treatment plan to be generated which caters to that person’s individual requirements. The equipment and techniques have their limitations and a perfect solution rarely if ever exists. This aspect of radiation therapy has been described as the point at which a science becomes an art-form. The practitioner employs their theoretical knowledge of anatomy, oncology, physics, human behaviour and research evidence in an applied manner to produce the best possible plan.

With the treatment plan, practitioners now have a set of instructions to deliver the treatment and an accurate prediction of where radiation dose will be deposited in the patient's body if the parameters of the plan are met within an acceptable tolerance level. The treatment plan functions in much the same way that an architect's blueprints provide a set of instructions on how to construct a building and an indication of what that building will look like when complete.

**Treatment**

The treatment section of workflow in a radiation therapy department is where all the elements described up to now are put into action. Over a period of time, which can range from a single day to seven weeks, the plan which has been generated for this individual is put into action. Using the information which the pre-planning and planning sections have generated, the patient is brought into a large room known as a bunker where the treatment machine is housed. There are some specialised variations and technologies utilised which are a legacy of older practices but most modern radiation therapy centres employ a type of machine known as a Linear Accelerator or LINAC. These are complex, highly specialised machines which constitute a high monetary investment both to purchase and maintain let alone staff. They are capable of producing the high energy X-Ray and
electron beams required in radiation therapy in a very precise fashion. They are so specialised that
only three companies globally produce such equipment, with some recent corporate developments
internationally, this will soon reduce to two.

While in the treatment room the patient will be placed on a treatment couch relative to the LINAC
so that the correct beam or more usually combination of beams can be applied to the target region
of their body. To do so, both the couch and the LINAC itself are capable of a complex set of
movements allowing a huge range of geometrical positions and arrangements. It is expected that the
equipment can physically produce what a treatment plan calls for but this is by no means
guaranteed as the machine will have certain physical limitations.

The positioning process is a bid to replicate the requirements of the treatment plan each time an
individual treatment or fraction is delivered. While a seemingly simple task, there are considerations
which can make the task complex. Internal organs are often capable of significant variation in shape
and volume occupied. The lungs expand and contact even whilst breathing quietly. What is known as
the tidal volume of air in and out of the lungs during such breathing is approximately 500 cubic
centimetres per breath and occurs 12-18 times per minute in the average person. Given that the
tumour being targeted might only be five cubic centimetres or less and is located to a tolerance of
two millimetres of distance this presents a significant problem to be solved. The treatment plan
must take such movement and inconsistency into account but that accounting in itself can only
tolerate so much deviation. The risk of inaccurate treatment delivery is that inadequate dose is
delivered to the cancer so the disease is not properly dealt to and/or unacceptably high levels of
dose are delivered to normal tissue causing significant impact on quality of life and function both in
the short and longer terms. For the best possible delivery of treatment therefore, RTs must not only
understand the capabilities of their equipment and be able to follow the instructions to deliver
treatment as planned; they must also adapt as parameters around the patient change in real time
either during the treatment (intra-fraction) or between treatments (inter-fraction).
Appendix D

Student participant information sheet

What is the impact of the VERT virtual reality system on the ability of second year BRT students to evaluate radiation therapy treatment plans?

INFORMATION SHEET FOR PARTICIPANTS (Students)

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

The Department of Radiation Therapy, UOW has recently acquired VERT, an immersive, virtual reality radiation therapy training system. Over the coming year this technology will be integrated into the teaching of radiation therapy students. Simulation technology has been used for a number of years in the training of health professionals and the literature around this technology tends to be positive about such technology’s usefulness in developing clinical skills. The project aims to investigate the impact on teaching practice, student learning and assessment outcomes with particular reference to the skills associated with radiation therapy planning concepts in the second year of the programme. The RADT216 paper requires students to demonstrate the ability to generate and critically appraise treatment plans for a variety of scenarios. We wish to investigate student and staff perceptions of the impact of VERT on the teaching and learning of these particular skills and measure any effect on learning outcomes for students.

This project is being undertaken as part of the requirements for the MHealSc in Clinical Education being undertaken by Paul Kane (the investigator).

What Type of Participants are being sought?

We are asking students enrolled in RADT216 to volunteer to participate in this study. Your will not be asked to provide any information identifying you personally. You will be sent an email providing a link to an online survey, inviting you to take part.

What will Participants be Asked to Do?

Should you agree to take part in this project, the invitational email will ask you to follow a link….

- Complete an online survey provided over the course of the academic year:
  - The first part will be made available in the early part of semester 2
  - The second part will be made available in the middle of semester 2
  - The third and final part will be made available at the end of semester 2

- The questionnaire will ask you a series of questions about your perceptions on the impact VERT may or may not have on your learning experience for this paper.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

What Data or Information will be Collected and What Use will be Made of it?
The data we collect from you via the questionnaire will include demographic information such as your gender, ethnicity and age.

The rest of the questionnaire data will be comprised of your responses to questions about your perceptions concerning the impact on your learning experience of using VERT in RADT216.

All data will be collected electronically.

Your responses will be completely anonymous, it is not possible to link any individual to the responses provided. Responding to the invitation to the online survey will be deemed to be informed consent to participating.

The data collected will be securely stored in such a way that only the investigator and his supervisors will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand).

As the data collected will not be attributable to any individual it will not be possible to view the data collected as part of this study.

A summary of the findings of the study will be made available to you upon request. Please contact the investigator if you wish to receive these findings.

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

*This proposal has been reviewed and approved by the Department of Radiation Therapy, University of Otago, Wellington and the Higher Education Development Centre (HEDC), University of Otago, Dunedin.*
What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Paul Kane and/or Dr Sarah Stein
Department of Radiation Therapy HEDC
04 8061755 03 4795360
paul.kane@otago.ac.nz sarah.stein@otago.ac.nz

This study has been approved by the Department stated above. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Appendix E
Student Online Survey

1. Prior to your entry to the BRT programme were you aware of the concept of virtual reality?
2. If yes can you explain further?
3. Prior to entry to the BRT programme, were you aware of the existence of virtual reality technology in the field of radiation therapy?
4. If yes, can you please explain further?
5. Have you ever used any other virtual reality technology, either in a learning or entertainment environment?
6. If yes can you please elaborate?
7. Do you consider yourself to be a visual learner?
8. Do you consider yourself to be a group learner?
9. Can you explain some more about how you prefer to learn?
10. Can you please describe what (if anything) you already know about the VERT system?
11. Can you please explain HOW you came to know about VERT?
12. What do you understand to be the role of the VERT system (in general)?
13. What do you understand to be the role of VERT in THIS department?
14. Do you have any ideas or expectations how you think the VERT system should be used?
15. Thinking about your planning skills at this point of the programme, how do you rate your own understanding of planning concepts?
16. Do you think time spent in clinical practice has improved your understanding of planning concepts?
17. Can you explain your response to the previous question?
18. Do you feel you have a good understanding of how you might further improve your understanding of planning concepts?
19. Can you explain your response to the previous question?
20. Do you have any other comments or suggestions you wish to make at this point?
Appendix F
Student participant information sheet

What is the impact of the VERT virtual reality system on the ability of second year BRT students to evaluate radiation therapy treatment plans?

INFORMATION SHEET FOR PARTICIPANTS (Students)

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

The Department of Radiation Therapy, UOW has recently acquired VERT, an immersive, virtual reality radiation therapy training system. Over the coming year this technology will be integrated into the teaching of radiation therapy students. Simulation technology has been used for a number of years in the training of health professionals and the literature around this technology tends to be positive about such technology’s usefulness in developing clinical skills. The project aims to investigate the impact on teaching practice, student learning and assessment outcomes with particular reference to the skills associated with radiation therapy planning concepts in the second year of the programme. The RADT216 paper requires students to demonstrate the ability to generate and critically appraise treatment plans for a variety of scenarios. We wish to investigate student and staff perceptions of the impact of VERT on the teaching and learning of these particular skills and measure any effect on learning outcomes for students.

This project is being undertaken as part of the requirements for the MHealSc in Clinical Education being undertaken by Paul Kane (the investigator).

What Type of Participants are being sought?

We are asking students enrolled in RADT216 to volunteer to participate in this study. You will not be asked to provide any information identifying you personally. You will be sent an email inviting you to participate in focus group discussions around this topic.

What will Participants be Asked to Do?

Should you agree to take part in this project, the invitational email will provide you with a date, time and place where a focus group discussion will happen and will be invited to participate in this.

- The group will be facilitated by an independent researcher unconnected to the department or its teaching programme.
The group discussion will be audio recorded and transcribed. The investigators will not have access to the audio recording, only an anonymised transcript.

You will be asked to provide informed consent to participating in the focus group discussion.

Food and drink will be provided as recognition of your participation.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

What Data or Information will be Collected and What Use will be Made of it?

The focus group discussions will not record any personal or demographic data.

The discussion will be audio recorded.

Your contributions will be anonymous. The independent facilitator will provide the recordings to an independent transcriber who will provide a transcript of the recording to the investigator which will be devoid of any means of identifying the participants.

The transcription data collected will be securely stored in such a way that only the investigator and his supervisors will be able to gain access to it. At the end of the project any data will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand).

As the data collected will not be attributable to any individual it will not be possible to view the data collected as part of this study.

A summary of the findings of the study will be made available to you upon request. Please contact the investigator if you wish to receive these findings.

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

This proposal has been reviewed and approved by the Department of Radiation Therapy, University of Otago, Wellington and the Higher Education Development Centre (HEDC), University of Otago, Dunedin.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Paul Kane and/or Dr Sarah Stein
This study has been approved by the Department stated above. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Appendix G
Student Focus Group Schedule

Focus Group 18th October: Schedule

Tell me about how VERT has been used with you as students.

Follow up ideas:

- Frustration – lack of exposure
- Worth the investment? Alternatives?
- Mostly for first year teaching?
- How well staff seem to be able to use VERT?
- Has usage changed over the course of the semester?

Are there things you could do with VERT that you could NOT otherwise do either in class or on placement?

Follow up ideas:

- Experimentation
- Visualisation
- Different appreciation of the plans you generate?
- Does VERT add anything for you at all? How much is this affected by previous answers?

How would you use VERT?

Follow up ideas:

- Are there particular concepts you think it would help with?
- Would discussion time be spent differently? With staff? With peers?
- Would access to VERT similar to that for Eclipse help?
- Would preparation for VIVAs be any different?
- Would there be any limits to this? Would 2nd year input be “worth” more than 1st? What about 3rd?
Appendix H

Staff Participant Information Sheet

What is the impact of the VERT virtual reality system on the ability of second year BRT students to evaluate radiation therapy treatment plans?

INFORMATION SHEET FOR PARTICIPANTS (Staff)

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

The Department of Radiation Therapy, UOW has recently acquired VERT, an immersive, virtual reality radiation therapy training system. Over the coming year this technology will be integrated into the teaching of radiation therapy students. Simulation technology has been used for a number of years in the training of health professionals and the literature around this technology tends to be positive about such technology’s usefulness in developing clinical skills. The project aims to investigate the impact on teaching practice, student learning and assessment outcomes with particular reference to the skills associated with radiation therapy planning concepts in the second year of the programme.

The RADT216 paper requires students to demonstrate the ability to generate and critically appraise treatment plans for a variety of scenarios. We wish to investigate student and staff perceptions of the impact of VERT on the teaching and learning of these particular skills and measure any effect on learning outcomes for students.

This project is being undertaken as part of the requirements for the MHealSc in Clinical Education being undertaken by Paul Kane (the investigator).

What Type of Participants are being sought?

We are asking staff who teach on this paper to participate
You will not be asked to provide any information identifying you personally.

What will Participants be Asked to Do?

Should you agree to take part in this project, you will be asked to take part in a series of one on one semi-structured interviews with the investigator.

The interviews will take place early in semester 2, around the middle of the semester and at the end of the semester.
The intent is to investigate your perceptions around using VERT in your teaching and how it might impact on student learning. By using a series of interviews we will be able to track if and how these perceptions develop over the teaching period under examination. Due to the nature of this study design and how the interviews will be conducted we cannot tell you exactly what questions you will be asked but some example questions have been provided.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

What Data or Information will be Collected and What Use will be Made of it?

- The data we collect from you via the interview will include demographic information such as your gender, ethnicity and age.

- The rest of the interview data will be comprised of your responses to questions about your perceptions concerning any impact on your teaching and student learning experience from using VERT in RADT216.

- The interviews will be audio recorded for later transcription and analysis.

- You may at any time request to see the data held which has been provided by you.

- The data collected will be securely stored in such a way that only the investigator and his supervisors will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

- The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand).

- A summary of the findings of the study will be made available to you upon request. Please contact the investigator if you wish to receive these findings.

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

This proposal has been reviewed and approved by the Department of Radiation Therapy, University of Otago, Wellington and the Higher Education Development Centre (HEDC), University of Otago, Dunedin.
What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Paul Kane and/or Dr Sarah Stein
Department of Radiation Therapy HEDC
04 8061755 03 4795360
paul.kane@otago.ac.nz sarah.stein@otago.ac.nz

This study has been approved by the Department stated above. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Appendix I
Interview Schedule Academic Staff Interview 1

- Can you tell me something about your role with regards to students?
- Tell me about how you found yourself in that role?
- I would like to hear about your overall approach to teaching, perhaps tell me about your beliefs and experiences which have shaped that approach.
- Can you tell me what you know or have experienced with regard to VERT technology?
- Do you have particular expectations of those who have been able to use VERT as part of their learning?
- Tell me how you deal with new technology in any context?
- What about in the work setting?
- What would you expect to gain from a VERT installation in your clinical department?
- Why is that?
- Thinking about the students currently under your supervision, do you perceive there to be any differences in the learning or conceptual understanding compared to students you previously were responsible for?
- If yes, to what do you attribute those differences?
Appendix J
Interview schedule academic staff interview 2

1. What has worked well this year with regards to VERT?
2. What has not worked well?
3. Will you do anything differently next year?
4. Is there a single learning from using VERT for you?
5. Have you changed your mind in any way about VERT?
6. How is your confidence with the system?
7. How do you think this has worked out for the students?
8. Where do you see your role with VERT go from here?
Appendix K

Clinical Staff Participant Information Sheet

What is the impact of the VERT virtual reality system on the ability of second year BRT students to evaluate radiation therapy treatment plans?

INFORMATION SHEET FOR PARTICIPANTS (Honorary Staff)

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

The Department of Radiation Therapy, UOW has recently acquired VERT, an immersive, virtual reality radiation therapy training system. Over the coming year this technology will be integrated into the teaching of radiation therapy students. Simulation technology has been used for a number of years in the training of health professionals and the literature around this technology tends to be positive about such technology’s usefulness in developing clinical skills. The project aims to investigate the impact on teaching practice, student learning and assessment outcomes with particular reference to the skills associated with radiation therapy planning concepts in the second year of the programme. The RADT216 paper requires students to demonstrate the ability to generate and critically appraise treatment plans for a variety of scenarios. We wish to investigate student and staff perceptions of the impact of VERT on the teaching and learning of these particular skills and measure any effect on learning outcomes for students.

This project is being undertaken as part of the requirements for the MHealSc in Clinical Education being undertaken by Paul Kane (the investigator).

What Type of Participants are being sought?

We are asking staff who are involved with the clinical training of students to participate.

You will not be asked to provide any information identifying you personally.

What will Participants be Asked to Do?

Should you agree to take part in this project, you will be asked to take part in one on one semi-structured interviews with the investigator.

The interviews will take place after semester 2 of the 2013 teaching year.

The intent is to investigate your perceptions how VERT may have impacted on student learning around the topic of radiation therapy planning concepts.

Due to the nature of this study design and how the interviews will be conducted we cannot tell you exactly what questions you will be asked but some example questions have been provided.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

What Data or Information will be Collected and What Use will be Made of it?

- The data we collect from you via the interview will include demographic information such as your gender, ethnicity and age.
The rest of the interview data will be comprised of your responses to questions about your perceptions concerning any impact on student learning as a consequence VERT being used in the teaching of students.

The interviews will be audio recorded for later transcription and analysis.

You may at any time request to see the data held which has been provided by you.

The data collected will be securely stored in such a way that only the investigator and his supervisors will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand).

A summary of the findings of the study will be made available to you upon request. Please contact the investigator if you wish to receive these findings.

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

This proposal has been reviewed and approved by the Department of Radiation Therapy, University of Otago, Wellington and the Higher Education Development Centre (HEDC), University of Otago, Dunedin

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Paul Kane and/or Dr Sarah Stein
Department of Radiation Therapy HEDC
04 8061755 03 4795360
paul.kane@otago.ac.nz sarah.stein@otago.ac.nz

115
This study has been approved by the Department stated above. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Appendix L
Interview schedule Clinical Staff Interviews

- Can you tell me something about your role with regards to students?
- Tell me about how you found yourself in that role?
- I would like to hear about your overall approach to teaching, perhaps tell me about your beliefs and experiences which have shaped that approach.
- Can you tell me what you know or have experienced with regard to VERT technology?
- Do you have particular expectations of those who have been able to use VERT as part of their learning?
- Tell me how you deal with new technology in any context?
- What about in the work setting?
- What would you expect to gain from a VERT installation in your clinical department?
- Why is that?
- Thinking about the students currently under your supervision, do you perceive there to be any differences in the learning or conceptual understanding compared to students you previously were responsible for?
- If yes, to what do you attribute those differences?
Appendix M

Participant information sheet for Inventor

What is the impact of the VERT virtual reality system on the ability of second year BRT students to evaluate radiation therapy treatment plans?

INFORMATION SHEET FOR Prof Andy Beavis

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you and we thank you for considering our request.

What is the Aim of the Project?

The Department of Radiation Therapy, UOW has recently acquired VERT, an immersive, virtual reality radiation therapy training system. Over the coming year this technology will be integrated into the teaching of radiation therapy students. Simulation technology has been used for a number of years in the training of health professionals and the literature around this technology tends to be positive about such technology’s usefulness in developing clinical skills. The project aims to investigate the impact on teaching practice, student learning and assessment outcomes with particular reference to the skills associated with radiation therapy planning concepts in the second year of the programme. The RADT216 paper requires students to demonstrate the ability to generate and critically appraise treatment plans for a variety of scenarios. We wish to investigate student and staff perceptions of the impact of VERT on the teaching and learning of these particular skills and measure any effect on learning outcomes for students.

This project is being undertaken as part of the requirements for the MHealSc in Clinical Education being undertaken by Paul Kane (the investigator).

What Type of Participants are being sought?

We are seeking the input of Prof Andy Beavis, co-founder of VERTUAL and inventor of the VERT system.

What will Participants be Asked to Do?

Should you agree to take part in this project you will be asked a series of questions about your perceptions of the intended purpose of the VERT system at time of inception and how this has developed. Sample questions are provided for your considerations. If time does not permit you will be provided with written questions and you will be asked to provide responses in writing by for example email communication.
Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

What Data or Information will be Collected and What Use will be Made of it?

- The discussion will not record any personal or demographic data
- The discussion will be audio recorded
- The recording will be transcribed.
- The transcript will be provided to you for your consideration. Amendments may be made to your responses.
- If time does not permit an interview, you will be provided written questions and you will be asked to provide written responses for instance by email.
- The transcription data collected will be securely stored in such a way that only the investigator and his supervisors will be able to gain access to it. At the end of the project any data will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.
- The results of the project may be published and will be available in the University of Otago Library (Dunedin, New Zealand).
- A summary of the findings of the study will be made available to you upon request. Please contact the investigator if you wish to receive these findings.

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

This proposal has been reviewed and approved by the Department of Radiation Therapy, University of Otago, Wellington and the Higher Education Development Centre (HEDC), University of Otago, Dunedin
What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:

Paul Kane and/or Dr Sarah Stein

Department of Radiation Therapy HEDC

04 8061755 03 4795360

paul.kane@otago.ac.nz sarah.stein@otago.ac.nz

This study has been approved by the Department stated above. If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479-8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Appendix N
Full Example of Coding Process

Initial Code – Financial Concerns

“I would expect it to be used as much as possible since it was a big investment money wise to be spent.”

“Very frustrated to not have had the experience on VERT which we thought we would of had by now. There isn’t much point in spending a fortune on something that is going to be used very infrequently. PLEASE give us some exposure to it!”

“At the moment VERT doesn’t seem like it was worth all of the money spent on it as it only takes a day on clinical to learn how the machine functions and what buttons to press on the pendant. More computers or Eclipse of our laptops would have been much more valuable to us.”

Initial Code – Access for Students

“M: We don’t have any- It’s locked.
F: We- it’s locked away. So we can’t access
M: Yeah, which I think’s ( ) that we don’t get ( ) access to it- and I can understand why, its a million dollars. Not all lecturers are using it. But, maybe later down the line, (implement it so) students do have access to it, to be able to be able to use it in their own time. “

“And although it is really new and really expensive, I feel like it would be nice to have bit more trust from the lecturers using it. Like as students. Cause I feel like it’s so precious, like we’re almost too scared to use it, and like it would be good to be- for us to be confident with it as well”

“F: think we are quite open though, to like using Vert. If we got the opportunity.
F: Yeah.
I: It’s ( ).
F: We have been slamming it a bit, but we’re definitely open to using it.
F: If we just had the opportunity”

“Very frustrated to not have had the experience on VERT which we thought we would of had by now. There isn’t much point in spending a fortune on something that is going to be used very infrequently. PLEASE give us some exposure to it!”
Initial Code – Students claim as stakeholders

“F: or even feedback from us, like- I mean this is feedback, but um, just like, I don’t know-

F: I suppose like they are asking us what we want to use it for, but because we don’t know what it can do, like we’re not too sure what it can be used for. So it’s kind of just a circle.”

“yeah. I- I- I almost think it would be helpful to have a presentation on what Vert can actually do, to us students, and then let- let us go away and think about it, and come back and say ‘okay, well we think Vert would be good for this, X, Y and Z, but we don’t think it would be good for this and that, that it’s capable of.’ I think then that would nullify that problem of having no idea what it can actually do and can’t do.”

Notes/Memo

This group tends to be introverted. Interesting they have taken the opportunity to vocalise. Not general rants, they have contemplated and reflected. Trying hard to consider wider implications.

Impact is my main question. How can we have impact without use? Does not stop impact but does limit. Comparison to how they use existing technology, capital investment is also high but they have much better access. Why? Where does lack of confidence come from? They need a chance to address their own confidence.

We put significant store by student input. Part of our teaching and learning QA process. Must investigate the idea of negotiated curriculum. Perhaps impact would be greater if action research type approach was taken, anyone who is involved is taken into account. Strong sense they have a contribution to make, perhaps even take load of staff?

They are not distancing themselves from the process. Rather they want to be part of it. FRUSTRATION – lack of use, given resource diverted

Limited access, they have difficulty with reasons for this

Don’t feel they are part of the process

Would FRUSTRATION be a fit for a number of initial codes?

Focused code FRUSTRATION seems like a good fit. Has ability to move from descriptive/action code to something more conceptual.