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Improving student learning through virtual means

Michelle Mary McEvoy
Royal College of Surgeons in Ireland

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IMPROVING STUDENT LEARNING THROUGH VIRTUAL MEANS

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**A thesis submitted to the Royal College of Surgeons in Ireland for the
degree of MD**



April 2014

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CANDIDATE THESIS DECLARATION

I declare that this thesis, which I submit to RCSI for examination in consideration of the award of a higher degree, MD Doctor of Medicine, is my own personal effort. Where any of the content presented is the result of input or data from a related collaborative research programme this is duly acknowledged in the text such that it is possible to ascertain how much of the work is my own. I have not already obtained a degree in RCSI or elsewhere on the basis of this work. Furthermore, I took reasonable care to ensure that the work is original, and, to the best of my knowledge, does not breach copyright law, and has not been taken from other sources except where such work has been cited and acknowledged within the text.

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Abstract

Virtual Patients are used in medical education but research evidence to guide their use is still modest. This research was designed to test the hypothesis that the use of Virtual Patients does not significantly improve the development of clinical knowledge, professional identity and reflective skills in undergraduate medical students. The research questions addressed were: (i) Based on an evaluation of current undergraduate training, is there a need to supplement the traditional paediatric curriculum to ensure that all students receive equivalent educational experiences?: (ii) Are Virtual Patients an effective learning tool in undergraduate education? Following an evaluation of the current curriculum, an online Virtual Patient model, and an instrument for assessing it, were developed and assessed in 181 undergraduate medical students and 25 postgraduate trainees. A multi-level mixed method approach (logbook reviews, focus groups, questionnaires, MCQs, problem-based questions, professional dilemma cases and semi-structured observer ratings) was used to assess the impact on clinical knowledge, professional identity and reflective capacity. The current curriculum did not provide adequate exposure to essential infrequent cases in clinical practice and students were not receiving equivalent educational exposure. Virtual Patients provided an acceptable learning tool and the measure developed for evaluating their impact was practical, reliable and valid. Compared to the traditional curriculum alone, exposure to Virtual Patients significantly improved short-term learning and long-term knowledge retention. Providing students with written feedback during the module improved their learning about professional norms and their ability to apply such norms to clinical scenarios. A semi-structured, observer-rated instrument was shown to have acceptable psychometric properties as a measure of students' responses to videos designed to evoke reflection. Female, postgraduate and academically higher performing students were significantly more likely to engage in deeper reflection. Guided reflection improved students' ability to reflect, but may not encourage students who do not have a natural tendency to reflect, to engage in the process. In conclusion, Virtual Patients are acceptable learning tools for improving clinical learning while simultaneously promoting the development of professionalism and reflective abilities in undergraduate medical students.

Chapter 1

Introduction

1.1 Introduction

Medical education is undergoing rapid change. Increasing student numbers, shorter hospital stays, super-specialisation and increased service demands have made the traditional teaching model increasingly unsustainable. We need to develop new methods and approaches that can support both undergraduate education and postgraduate training. However, it is important to ensure that any changes to the traditional curriculum are evidence-based and grounded in sound educational theory. In parallel with this, medical education requires more than merely the assimilation of knowledge. Students must be prepared to become members of a community of practice.

Child abuse is a major issue in society and the recognition and management of child abuse is an important component of training for all doctors. The diagnosis of child abuse is particularly challenging and the training of doctors in this skill even more so. It is essential that all medical students and trainees have adequate exposure to cases of child abuse in their training but the nature of the problem presents particular challenges for medical educators. One possible approach is to use Virtual Patients.

Virtual Patients represent a heterogeneous group of new learning tools that are being developed to support the traditional teaching model. Although various patterns, categories and features to guide their development are emerging from the literature, it is still not clear what design features promote the most effective learning. Focusing attention on the best type of instructional method to be used can help facilitate more effective learning within a Virtual Patient module.

The aim of this thesis is to develop and evaluate the effectiveness of an online Virtual Patient module for developing clinical knowledge, professional identity and reflective skills in undergraduate students and postgraduate trainees in the area of child abuse.

The research questions addressed are:

1. Based on an evaluation of current undergraduate training, is there a need to supplement the traditional paediatric curriculum to ensure that all students receive equivalent educational experiences?
2. Are Virtual Patients an effective learning tool in undergraduate education?

The following provides an overview of the thesis structure:

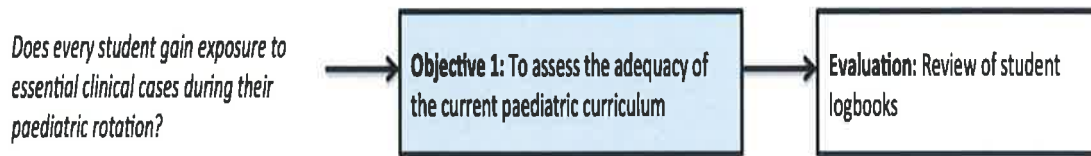
- Chapter 2 reviews the literature.
- Chapter 3 outlines the study hypothesis, aims, objectives and research questions and described the methodology used in the thesis
- Chapter 4 presents the results of the study
- Chapter 5 discusses the study findings, limitations and provides recommendations for further research.

The following provides an outline of how the study's three research objectives will be addressed in the thesis. In order to aid the reader, a study flow sheet has been developed illustrating how each research objective will be addressed to answer the study's research questions. This flow sheet will be used throughout the thesis to guide the reader.

1.2 Research objective 1

The first objective of the study is to assess the adequacy of the current undergraduate curriculum to determine if every student gains exposure to essential clinical cases during their paediatric rotation. This is addressed by conducting a review of student logbooks to answer research question 1: *Based on an evaluation of current undergraduate training, is there a need to supplement the traditional undergraduate paediatric curriculum to ensure students receive equivalent educational experiences to one another?* (Figure 1.2)

Figure 1.2 Point in study flow sheet: Research objective 1

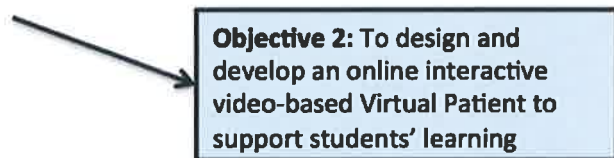


1.3 Research objective 2

Based on a review of the literature and supported by the findings from the review of student logbooks, the need to develop an educational resource to explicitly teach about the recognition and management of suspected child abuse was identified. The second objective of the study: To design and develop an online interactive video-based Virtual Patient to support students' learning is described, as a reflective account, written in the first person, in Chapter 5. (Figure 1.3)

Figure 1.3 Point in study flow sheet: Research objective 2

Literature: The recognition and management of suspected child abuse is an essential case which all students should be explicitly taught



1.4 Research objective 3

The final objective of the study: To evaluate the effectiveness of the module and determine the means by which its impact can be optimised, is determined by answering four research sub-questions about the effectiveness of the Virtual Patient module.

1.4.1 Research sub-question 2.1: Acceptability

Are Virtual Patients an acceptable learning tool?

Three separate evaluations are described:

1. Focus group evaluation of undergraduate paediatric medical students
2. Development of a questionnaire to assess the module
3. Postgraduate trainee evaluation of the Virtual Patient module used to facilitate a case based discussion

1.4.2 Research sub-question 2.2: Clinical knowledge gain

Do Virtual Patients improve clinical knowledge?

A pre and post module MCQ and problem-based learning question is used to assess students' short and long term knowledge gains after completion of the Virtual Patient module.

1.4.3 Research sub-question 2.3: Professional identity

Do Virtual Patients have a role to play in the development of students' professional identities?

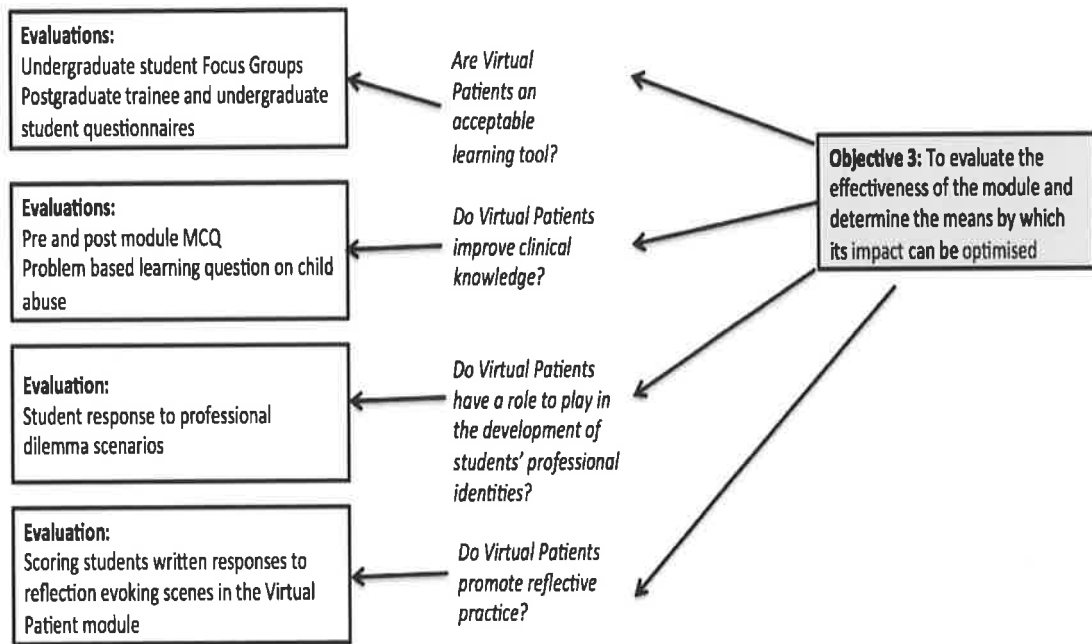
Students' responses to three professional dilemma scenarios within the Virtual Patient is used to evaluate whether giving feedback to students during the course of the module influenced their subsequent responses to professional dilemma scenarios.

1.4.4 Research sub-question 2.4: Reflective practice

Do Virtual Patients promote reflective practice?

A semi-structured observer-rated instrument is used to measure students' responses to reflection evoking scenes within the Virtual Patient module and determine whether guidance can improve students' reflective abilities. (Figure 1.4)

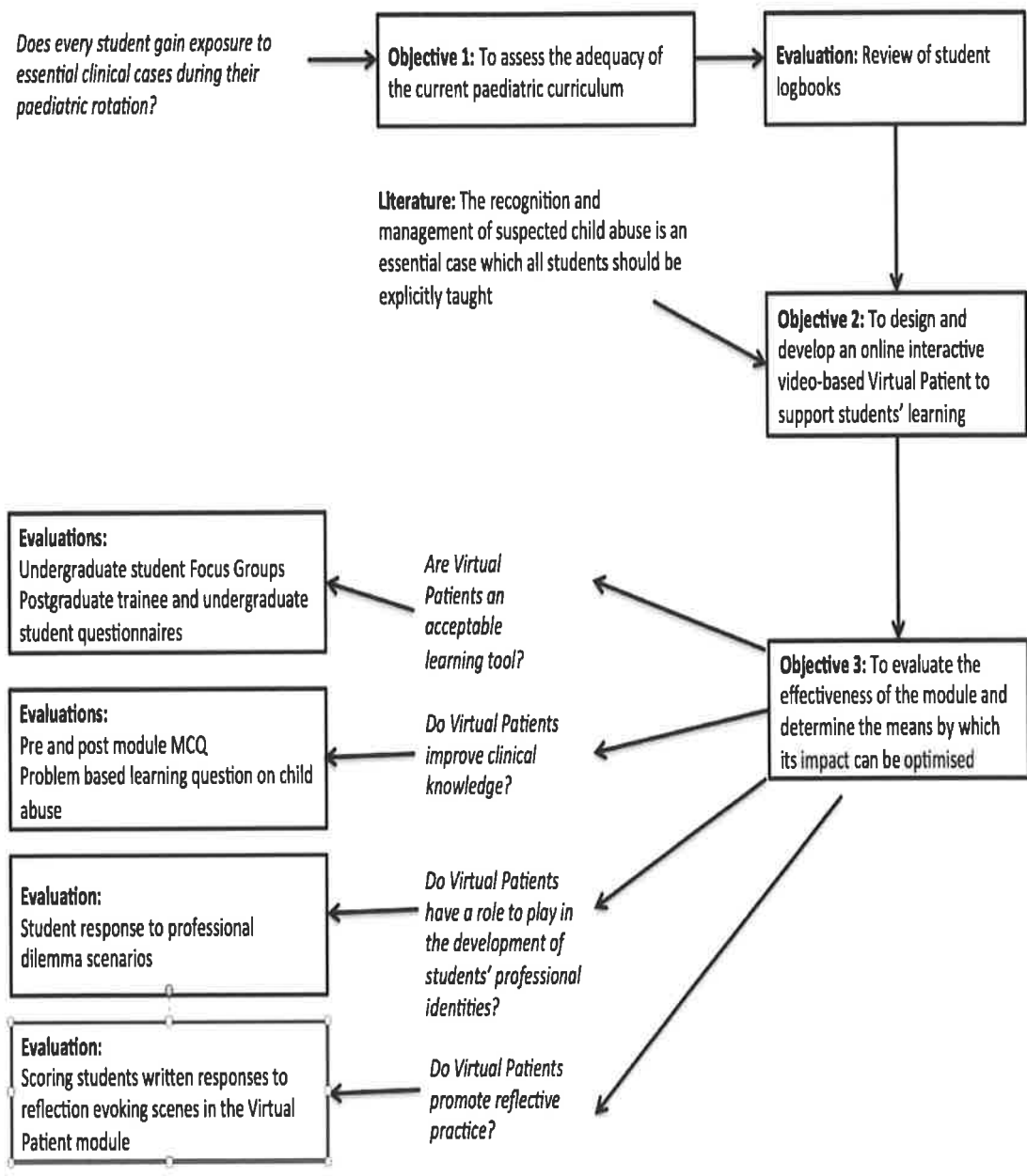
Figure 1.4 Point in study flow sheet: Research objective 3



1.5 Summary

The following study flow sheet summarises how the study's three research objectives will be addressed in the thesis. (figure 1.5) To address research objective 1, a review of student logbooks will be undertaken. This will determine if students are gaining exposure to essential clinical cases during their paediatric rotation. A Virtual Patient module to support student's learning will then be developed. To evaluate the impact of this module and determine the means by which its impact can be optimised, four inter-connected evaluations will be performed to determine the modules acceptability as a learning resource and its impact of learning, professional development and reflective capability.

Figure 1.5 Study flow sheet



Chapter 2

Literature review

2.1 Introduction

This chapter reviews the literature associated with the main areas of interest of the thesis. It begins with a review of the apprenticeship model and the threats that have made this traditional model unsustainable. Recognising that we need to change our approach to teaching and learning in the 21st century, it then explores relevant theories that should inform future changes and research in medical education.

In order to determine, what aspects of clinical teaching are most in need of intervention, the review then goes on to look at logbooks as a means to evaluate curricula and identify deficiencies in students' clinical experiences.

To support the need to augment the traditional curricular approach to teaching and learning about child abuse at both undergraduate and postgraduate level, a review of the literature on child protection training is described. The review highlights the need for more evidence based training interventions to support both undergraduate and postgraduate education in this area.

Published research on the use of Virtual Patients as a learning resource in medical education is then reviewed. The various patterns, categories and features that are emerging from the literature are discussed and gaps in the literature identified.

The theories behind multimedia learning and the need to focus on the type of instructional method used are then considered, as these are important factors in the development of any e-learning resource.

Finally, the need to explicitly address professionalism and reflective practice in the undergraduate medical curriculum is discussed, specifically the role which multimedia could potentially play in facilitating student reflection and the teaching and assessment of professional behaviour.

A literature review of published peer reviewed research was performed searching the main databases including Medline, Embase and CINHAL. Key search terms included: Virtual Patient, professionalism, teaching, learning, e-learning, simulation,

training, undergraduate, postgraduate, curriculum, reflection, assessment, child abuse. Additional articles were obtained by reviewing references from systematic reviews and meta-analyses. In addition, the following publications were hand searched for relevant articles:

- Medical Education
- Medical Teacher
- Academic Medicine
- Clinical Teacher

2.2 Traditional medical education

2.2.1 The apprenticeship model

Traditionally, it was assumed that medical students would learn the art and science of medicine from daily encounters with patients. The apprenticeship model is one of the oldest forms of ‘learning by doing’, whereby the novice learns how to perform tasks under the supervision and guidance of an expert. During a clinical apprenticeship, students are provided with opportunities to practice clinical skills under the supervision of experienced clinicians who provide constructive feedback within the working environment. It is through this interaction with a more experienced physician, that the novice transcends what he/she can do alone and develops as a professional.

The principles of learning underpinning the apprenticeship model are:

- Knowledge is individually constructed by learners
- Knowledge construction is mediated by others
- Knowledge construction is most effective when activities are authentic
- Knowledge construction is context-dependence¹

The apprenticeship model is supported by Kolb’s theory of experiential learning in which meaningful learning is constructed in the context of real-life clinical settings.² The novice student observes how the clinician interacts with a patient (concrete

experience). The student, with guidance from the clinician, reflects on the experience and attempts to integrate this new knowledge into existing knowledge structures. He or she then, through the process of abstract conceptualization, begins to make sense of the experience and when subsequently presented with a similar experience, practices the skill under the supervision of the clinician. In doing so, 'Novices develop into experts by incrementally acquiring skills that depend on accruing experience'.³

Ashley concludes that the apprenticeship style approach has many strengths. The experienced clinician or mentor can adjust learning to match the level of the student. 'The mentor, acutely aware of the personal strengths and weaknesses of their student, can, over an extended period of time, tailor learning according to those needs. It provides the ideal setting to refine clinical skills, develop an understanding of professional roles and responsibilities and provides vast educational opportunities from which students, as members of the clinical team, can learn.'⁴

This apprenticeship model was central to Flexner's educational vision and changed the face of medical education. In the early 20th century, there was growing concern about the quality and standards of medical education in the United States. At the request of the American Medical Association's Council on Medical Education, Abraham Flexner, a non-physician educationalist, was recruited to advise the Carnegie Foundation for the Advancement of Teaching on how standards of medical education could be improved. Flexner visited all 155 medical schools in the United States and Canada. His 1910 report on medical education served as a catalyst for the reform of the standards, organization and curricula of North American medical schools.⁵

Based on Flexner's report the American Medical Association endorsed the following set of recommendations:

- Medicine is to be a university study with tough entry requirements
- There should be a smaller numbers of centres of excellence

- Active learning should be by enquiry and experiment i.e. education, not training
- The start should be a grounding in science
- Clinical learning should be from university employed, academic practitioners
- There should be a year of internship

2.2.2 Challenges to the apprenticeship model

Since Flexner's landmark report over 100 years ago, medical education has undergone significant changes in terms of its approach to teaching and learning. Although, the basic features outlined by Flexner remain in place (a university based scientific foundation followed by practical experience in clinical settings), we now are beginning to question the relevance of Flexner's report for contemporary medical education. The traditional apprenticeship model has come under severe strain. Increasing student numbers, shorter hospital stays, super-specialisation, advancing technologies, and increasing service demands have all made the traditional apprenticeship model unsustainable in everyday practice. As a result, we have seen a paradigm shift in our approach to teaching and learning.

In 2010, recognising that the practice of medicine and its scientific, pharmacological and technological foundations had been transformed, the Carnegie Foundation for the Advancement of Teaching, following in the footsteps of Flexner, published a report called "Educating Physicians: A Call for Reform of Medical School and Residency".⁶ The authors visited 11 of 130 medical schools and teaching hospitals accredited by the Liaison Committee for Medical Education of the Association of American Medical Colleges, and 3 non-university teaching hospitals. The report found several shortcomings in medical education:

- Clinical teaching is overly focused on inpatient experience in hospitals with limited capacity to teach
- Poor connection between formal knowledge and experiential learning
- Inadequate attention to patient populations, systems of health care delivery and effectiveness

- Inadequate opportunities for students to observe the course of a patient's illness and recovery over time
- Inadequate use of the learning sciences

Four goals for medical education were proposed:

1. Standardize learning outcomes and individualised learning processes
2. Integrate knowledge and clinical experience, roles and responsibilities
3. Develop habits of inquiry and improvement
4. Address professional identity formation explicitly

2.2.3 The Irish Experience

The wave of reform in medical education has been slow to reach Ireland.⁷ In 2001 and 2003 the Medical Council of Ireland published reports on undergraduate medical education in Ireland. The council stated 'There are real concerns about the quality of medical education in Ireland. Medical education is changing rapidly and Irish medical schools are struggling with standards'. The concerns highlight deficiencies in the traditional apprenticeship model and mirror many of the findings in the 2010 Carnegie Foundation report.

Within Ireland, there are several factors that threaten the traditional apprenticeship model:

Patient safety: Following the Institute of Medicine report, 'To Err is Human: Building a Safer Health System', the issue of patient safety has become of paramount importance. The long held paradigm of 'see one, do one, teach one' has become incompatible with ensuring the provision of safe patient care.⁸ Changing social and cultural values mean that the public, regulators, insurers and sponsors of healthcare teaching do not accept any compromise on patient safety in the name of medical training.⁹

Student numbers: ‘We must respond to the needs of medical students and aspiring medical students in opening up opportunities for entry to medicine and in ensuring that the quality of the education they receive keeps pace with best international standards.’ – Irish Minister for Education 2006.

In order to improve access to medical education, the Irish government in 2009 introduced several changes to the entry pathway for medical schools, in line with recommendations put forth in the Fottrell report ‘Medical Education in Ireland: A New Direction, Report on the Working Group on Undergraduate Medical Education and Training (2006). In order to gain a place in medical school, students finishing their second level education must now complete the Health Professions Admission Test-Ireland (HPAT), meet the requirements for each institution and perform competitively in the final Leaving Certificate examination.

We have also seen the introduction of a graduate entry program for medicine. Graduate students must obtain a minimum second class honours in their first bachelors degree and achieve a competitive GAMSAT score or Graduate Medical Schools Admission test score. There are now approximately 5,000 medical students in Irish medical schools, with places having increased over recent years in response to the Fottrell report. As a result, we are now finding it increasingly difficult to accommodate this increased student number in our hospitals. As more and more students cluster in the hallway and around the bedside, opportunities for individual student-patient contact diminishes.

Educational experience: The Liaison Committee on higher education states that all medical students should have equivalent educational experiences and achieve the same core competencies.¹⁰ However, in daily practice, this can be difficult to ensure. Throughout the course of their clinical training, medical students complete clinical attachments that can vary widely in terms of quality and coverage of the curriculum. Therefore, standardising educational encounters has become increasingly difficult as the growth in student numbers is leading to the expansion of teaching sites away from the main teaching centres.

Competing demands: Teaching is viewed as a core professional value in medicine and traditionally there has been a strong ethos among doctors to train their successors. Several governing medical bodies, including the UK General Medical Council¹¹ and the American Association of Medical Colleges have emphasised the responsibility of doctors to contribute to medical training.¹² According to the Report of the Working Group on Undergraduate Medical Education and Training (Fottrell Report) approximately half of the entire undergraduate medical curriculum in Ireland (i.e. clinical training) is carried out by doctors on a voluntary basis.¹³ However, teaching is afforded a lower priority than service delivery, research and administration. Although Non-Consultant Hospital Doctors (NCHDs) and consultants should view teaching as a core responsibility, they have no contractual obligation to teach. Therefore, the competing pressure from research and clinical commitments make teaching difficult in daily practice.

Shorter hospital stay: A key cost containment strategy for hospitals is reducing the length of stay in hospital. As a result of cost saving measures and advances in clinical care, patients now spend less time in hospital. This reduces opportunities for the face-to-face patient encounters which epitomised the apprenticeship style of learning ‘on the job’ through actual clinical experience.

Decentralization: The on-going reconfiguration of the health service, directed towards the provision of higher standards of patient care, is resulting in the amalgamation of small hospitals and the consolidation of specialist care into large centres of excellence. In addition, the decentralization of medical training is causing a shift away from tertiary academic teaching hospitals to smaller district general hospitals. These changes have implications for the delivery of medical education. For students in smaller district general hospitals, it can be difficult to ensure exposure to a sufficient number and variety of cases. In contrast, students in academic hospitals may have limited exposure to common conditions due to the complex nature and narrow scope of problems presented in highly specialised centres.

Funding: Funding for medical education in Ireland is poor in relative to other capital government expenditure. As a result there are low numbers of full-time medical school faculty in public medical schools.¹⁴ However, despite this, medical

student numbers are increasing and the competing demand on doctors to contribute to medical education and training while balancing service and research commitments continues to increase. This places huge pressure on institutions to maintain high standards of teaching in the face of limited resources.

2.2.4 Conclusion

Since Flexner's landmark report over 100 years ago, medical education has undergone significant reform in terms of its approach to teaching and learning. We can no longer rely on the apprenticeship model. Increasing student numbers, shorter hospital stays, super-specialisation and increased service demands have made the traditional model increasingly unsustainable.

2.3 Educational theory

2.3.1 Need for educational theory to inform practice

In order to continue to educate and train highly qualified doctors to support the delivery of health care in the 21st century, change is needed. However, there are concerns that changes in medical education continue to take place in the absence of supportive educational theory.¹⁵ In clinical practice, decisions are evidence based, supported by a strong research-driven knowledge base which informs diagnostics, treatment and management. However, in medical education, this supporting research framework is often lacking or at the very least unstable or unused. Perhaps this is because many educationalists see the gap between theory and practice as too wide to bridge. Educational research is seen as having little impact on everyday practice.¹⁶ However, Kaufman argues that, if we attempt to bridge that gap, we may produce more effective teachers, which will lead to better trained doctors and higher standards of patient care.¹⁷

Albert et al. conducted 23 semi-structured interviews with 'influential figures' from the medical education community to determine what form research in medical education should take and what role it should play. The results indicated that one of the four main reasons why research in medical education is often of poor quality is

the gaps that exist in theoretical knowledge. These deficiencies interfere with ‘the creation of an integrated body of knowledge related to important problems’ and limit ‘the understanding of the factors and causes underlying observed phenomena’.¹⁸ Gibbs provides insight into some of the reasons why theory is not readily applied to medical education research. He states that insufficient time, lack of formal training, uncertain relevance of the work from other specialities, confusion over terms and few references sources are the main contributing factors.¹⁹

2.3.2 Constructivism

Historically, medicine was strongly rooted in positivism which places high value on understanding the world through objective study and the development of knowledge that is value and context-free.²⁰ However, our current approach to teaching and learning is now more in-line with constructivist thinking. Constructivism is a theory describing how learning happens. Formalisation of the theory of constructivism is largely attributed to Jean Piaget, who suggested that, through the processes of *accommodation* and *assimilation*, individuals construct new knowledge from their experiences. Assimilation occurs when new experiences fit into a learner’s existing cognitive structures. Accommodation occurs when new experiences cannot be made to fit and therefore challenge those existing cognitive structures which then have to be changed. Kaufman argues that constructivism has four important implications for teaching and learning;¹⁷

1. The teacher does not transfer knowledge but acts as a guide to facilitate learning
2. Teachers should provide learning experiences that expose inconsistencies between students’ current understanding and their new experiences
3. Teachers should engage students in an active way
4. Sufficient time for in-depth examination of new experiences should be provided

Mann argues that significant changes have occurred in our understanding of the fundamental aspects of medical education. Firstly, we now understand that medical education is more than just the acquisition of knowledge, skills and attitudes. It is a

transformative process from layperson to professional. Secondly, problem solving and decision-making are more complex than just applying theoretical knowledge. They involve the integration and assimilation of developing knowledge. Finally, with the growing understanding that we are preparing medical students for future practice in an ever-changing environment, medical education is concerned with developing competency in 'how to learn' as well as in 'what to learn'.²⁰

Unlike many other theories, learning theories tend not be replaced by superior ones, but, rather, are incorporated into subsequent theories. Therefore, the theoretical perspectives that will reshape and reform medical education will still be grounded in the past, but will take cognisance of the future. With the recognition that learning takes place in an ever-changing socio-cultural environment, we are now entering an era of reconceptualization and restructuring. Socio-cultural theories, such as Community of Practice, have increasing relevance in modern medical education as they consider the development of professional identity and attributes within this environment.²¹

2.3.3 Communities of Practice

The concept of Community of Practice was originally developed to provide a framework for examining the learning that happens among practitioners in a social environment, a concept known as 'situated learning'.²² Community of Practice is defined as 'groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an on-going basis'.²³ Although the importance of Community of Practice is well established in industry, it is an evolving concept in medical education and, as such, research in this area is relatively new and limited. Shifting the focus to how the mind develops within its' cultural setting, offers an opportunity to explore how the workplace can be enhanced to support teaching.

In order for learning to occur, individual engagement is needed. However, as Billett highlights, there is a need for co-participation, or reciprocal 'workplace affordances'.²⁴ Workplace affordances determine the opportunities to participate in different kinds of goal directed activity as well as the support and guidance needed in

coming to know about those activities. Therefore, gaining an understanding of how medical students learn within our hospital setting may enable us to take advantage of opportunities to enhance the socio-cultural elements that influence learning.

Lave and Wenger describe learning as a process of social participation, whereby members join a community and learn at the periphery. Then, as their confidence and competence grows, they become more involved in the main processes of the particular community. For medical students, learning to become a member of the profession can be viewed as moving from this 'legitimate peripheral participation' into 'full participation'. Lave and Wenger suggest that the success of a community of practice depends on five factors.²² (Table 2.3.3)

Table 2.3.3 Lave and Wenger community of practice factors

Number	Factor
1	The existence and sharing by the community of a common goal
2	The existence and use of knowledge to achieve that goal
3	The nature and importance of relationships formed among community members
4	The relationship between the community and those outside it
5	The relationship between the work of the community and the value of the activity

If participation is central to learning, then deliberate exposure to clinical cases is needed. However, as outlined above, opportunities for deliberate practice in the clinical setting are hampered by several factors including case availability, case complexity, increased student numbers, limited resources and patient safety.

2.3.4 Conclusion

As medical education continues to evolve, it is important that research informs change in order to ensure that decisions are evidence based. Teaching and learning in medicine is about more than merely assimilating knowledge; it is about becoming members of a community. Therefore, students need to be provided with opportunities to participate and move from 'legitimate peripheral participation' into 'full participation' in a community of practice.

2.4 Case Exposure

2.4.1 Use of logbooks in undergraduate medical education

Logbooks are widely used in undergraduate medical education to document students' clinical experiences. A logbook can be defined as any method by which medical students document their learning experiences. When properly compiled and reviewed, logbooks (or encounter logs) in handwritten, electronic or optically scanned formats can serve as tools for evaluating and researching a range of educational outcomes.

In order to develop clinical competence, students must be exposed to a sufficient number and variety of patient encounters.²⁵ As a tool to monitor students' exposure to clinical cases, a logbook can help determine if course objectives are being met. Monitoring these experiences is essential to help ensure that students acquire an appropriate mix of clinical experience. Therefore, logbook information can play an important role in the planning, implementation and evaluation of educational experiences.²⁶ Links et al. found that logbooks helped identify content objectives that were not being met by students during their rotation and that consequently needed to be addressed by other educational activities.²⁷

Medical students increasingly spend part or all of their clinical training outside of the main teaching hospitals. Logbooks provide a means to monitor case exposure and ensure that students in different centres have equivalent learning opportunities. McCurdy et al. compared the paediatric patient encounters by students in a university medical centre to those in a community centre. They found that students rotating through community centres reported seeing over 3 times as many patients as students at the university hospital. Students in the community centre also reported seeing more routine illnesses compared to the uncommon disorders reported by students in the university medical centre.²⁸ Inconsistencies in case exposure between centres have also been reported in other specialities.²⁵

Due to increasing service demands and the time consuming nature of one-to-one bedside teaching, there are concerns about the level of supervision that medical

students receive.²⁹ Logbooks can be used to determine the appropriateness of supervision and student feedback. In doing so, they can help facilitate improvements and standardization of students' educational experiences.³⁰

2.4.2 Improving the efficiency and effectiveness of logbooks

We may not be utilising logbooks as efficiently and effectively as we think.³¹ Student logbooks tend to under-report the number of clinical cases that students encounter.³² Following evaluation of student logbook use, Vanek et al. made several recommendations to improve student compliance.³³ Subsequent studies have attempted to address these recommendations with limited success.³⁴ In order to assess the reliability of student logbooks, Raghoobar-Krieger et al. measured intra-observer agreement by comparing doctors' and students' data. They reported inconsistencies in student documentation that under-represented the available disease case-mix.³⁵

In recent years, as we have embraced technological advances, logbooks have become more sophisticated. However, merely changing the means by which students document their clinical experience does not ensure an educationally worthwhile student experience. A mixed method study by O'Brien et al. reported that students found a web-based patient encounter log to be of minimal educational value, and identified barriers to student use of the system that need to be overcome to support learning. These authors concluded that the support structure surrounding the technology needs to be improved, rather than just the technology itself.³⁶

2.4.3 Student case exposure and learning outcomes

The learning environment influences learning outcomes.³⁷ However, establishing a direct correlation between the number of patients seen and exam performance is difficult.³⁸ Previous studies have failed to show a relationship between the number or variety of cases and performance in end of rotation examinations.³⁹ A narrative review on logbook use in undergraduate education by Denton et al. in 2006 found a lack of sufficiently scientifically rigorous published articles connecting process (case exposure) to outcome (examination performance) in undergraduate education.⁴⁰

This may be because the effectiveness of any clinical experience is influenced by a combination of patient mix and supervision.⁴¹ Therefore, without sufficient guidance and supervision, students can have difficulty structuring their clinical learning experiences. The purpose of a logbook should be to provide structure and focus to learning and assessment in a supported supervised experiential learning environment.

2.4.4 Conclusion

In order to improve clinical programs, educators must gain an understanding of the 'actual' experiential learning of students and the relationship that that has to clinical performance. Logbooks are widely used in undergraduate medical education to document students' experiences. Studies have shown that logbook can provide useful information about deficiencies in the curriculum and can focus attention on areas for improvement and development.

2.5 Teaching about child abuse

2.5.1 Importance of recognition

Child abuse continues to be a major cause of death and disability, worldwide. International studies show that approximately 25-50% of all children report being physically abused.⁴² There are concerns regarding the ability of doctors to recognize and respond appropriately to child abuse and the likelihood of physicians reporting suspected child maltreatment is related to the amount of training they receive.⁴³ The Child Abuse Recognition Experience Study concludes that one of the main factors contributing to doctors' discomfort with the management of child abuse is their lack of education and training.^{44,45,46} Education of physicians in the field of child abuse is very limited and studies continue to highlight the need for more effective education and training across the continuum of medical education.⁴⁷

2.5.2 Undergraduate teaching and postgraduate training in the management of suspected child abuse

A review of the effectiveness of training interventions aimed at improving the identification and management of child abuse and its' neglect by health professionals identified only 15 training interventions.⁴⁸ The review concluded that there is a lack of an evidence-based approach to the design, implementation and critical evaluation of these interventions.

Child protection training is a particularly neglected area in undergraduate medical education and educational exposure to child protection varies greatly.⁴⁹ Although many medical schools now explicitly address the need to teach about the recognition and management of cases of suspected child abuse, there is little published data on the quantity or quality of medical student education in this area. It remains a difficult subject to teach as, in addition to learning clinical knowledge and skills, we also need to ensure that education promotes and supports the development of appropriate attitudes and feelings.

Effective education and training must equip doctors with a range of clinical competencies including history taking, clinical examination, documentation, communication skills and decision-making ability.⁵⁰ It must also promote the professional development of doctors as advocates for children's rights. As junior doctors are often the only doctors who assess children presenting with an injury or illness to an Emergency Department, it is crucial that they are skilled in the identification of possible child abuse or neglect. Research by MacLeod et. al. found that junior doctors working in their paediatric Emergency Department often failed to recognize standard indicators of abuse.⁵¹ Paediatric trainees' lack of knowledge would benefit from an increase in training opportunities.⁵²

2.5.3 Conclusion

Child protection should be a critical component of training for all doctors who have contact with children and their families. However, there are few published studies on child protection training and we may not be effectively teaching about child

protection at both undergraduate and postgraduate level. Teaching and learning about the recognition and management of child abuse requires more than just clinical knowledge acquisition. It requires an understanding of the role of the physician as an advocate for the rights of the child. There is a need for more evidence-based child protection training to support learning at both undergraduate and postgraduate level.

2.6 Virtual Patients

2.6.1 Introduction to Virtual Patients

In recent years there has been a growth in the number of publications concerning the use of Virtual Patients. Virtual Patients have been described in various ways, from a 'Specific type of computer program that simulates real-life clinical scenarios: learners emulate the role of health care providers to obtain a history, conduct a physical exam, and make diagnostic and therapeutic decisions'⁵³ to 'An interactive computer simulation of real-life clinical scenarios for the purpose of healthcare and medical training, education or assessment'.⁵⁴ The definitions are intentionally broad and all encompassing. This is because a wide variety of designs and structures fall under what can be described as an 'umbrella term' for a vast array of computer-based learning programs or 'low fidelity' simulations.

However, Virtual Patients are not new. In 1971, when computers first became available, Harless et al. described a computer-aided simulation.⁵⁵ As far back as 1999, Virtual Patients were even included in the United States Medical Licensing examination (USMLE) Step 3.⁵⁶ What has changed, however, has been the application of advancing technology to enhance Virtual Patients.

2.6.2 Advantages of Virtual Patients

Virtual Patients offer an alternative to the traditional approach of 'learning by doing' in a clinical situation, by utilizing developments in the technology of simulation and virtual reality. As an educational resource, Virtual Patients have several advantages over more traditional teaching methods to support the delivery of clinical teaching.^{57,58,59,60, 61} (Table 2.6.2)

Table 2.6.2 Advantages of Virtual Patients

Advantage	Explanation
Student access	Accessible to large number of students No limit to 'class' size Can be used by multiple users at same time
Case availability	Enables students to learn about both common and rare conditions Exposure to inpatient and outpatient cases
Repetitive practice	Allows for the repetitive and deliberate practice of 'clinical skills' by the learner
Flexibility	Provide flexibility in scheduling learning
Risk free	In a virtual learning environment there is not risk to either patient or student Learners have opportunities to practice in safe and responsive environment Environment offers 'permission to fail'
Reduce teaching burden	Relieves teaching burden on busy faculty Cost effective Modules easily updated and maintained online Modules can be shared and adapted
Self directed learning	Ability to incorporate questions with feedback Provides students with supplementary resources online Allows personal assessment
Acceptable	Students view Virtual Patients as acceptable learning tool
Standardisation	Provide standardised and well-structured educational encounters Ensure all students receive equivalent educational experiences and achieve the same core competencies
Independence from training sites	Provides consistent and quality teaching material regardless of training site Enables distance learning
Simulates real life	Allows students to complete complex tasks Provides opportunity to practice decision making, formulating ideas and generating differential diagnoses

2.6.3 Disadvantages of Virtual Patients

There are, of course, several recognized limitations of Virtual Patients. They are expensive to develop and are resource intensive to both develop and maintain. There are reports that they are difficult to integrate into the curriculum and offer a poor means of evaluating complex cognitive skills such as empathy, negotiation and breaking bad news.

In 2005, Huang et al. surveyed US and Canadian medical schools regarding their use of Virtual Patients. Of the 108 institutions that responded, only 24% were developing Virtual Patients. Production of Virtual Patient cases was expensive, with 85% of cases costing more than US\$10,000 to develop and 34% costing more than US\$50,000. They also required a significant time investment with an average production time of 16.6 months (range 1 to 60 months). In times of financial restraint it can be difficult for institutions to justify such a weighty investment.⁵⁴

In an effort to demonstrate that training teaching staff can reduce Virtual Patient development costs, Round et al. designed a workshop to teach staff how to create Virtual Patients with limited technical support. Although the authors demonstrated that staff were able to develop simple and inexpensive Virtual Patient modules, they failed to provide any evaluation of the educational value of these modules.⁶² In order to determine whether complex communication skills such as non-verbal behaviours and empathy were similar when students interacted with a virtual or a standardized patient, Deladisma et al. compared student interaction with both.⁶³ Students demonstrated nonverbal communication behaviours and responded empathetically to the Virtual Patient but the quantity and quality were less than that exhibited when interacting with the standardized patient. The authors concluded that further technological advancements could improve the use of Virtual Patients in the teaching and assessment of higher order communication skills.

Recognising that many physicians receive inadequate training in history taking and examination of women with breast complaints, Deladisma et al. developed a Virtual Patient scenario of a woman with a complaint of a breast mass. Although the study was small and had some methodological flaws, the authors found that interaction with the Virtual Patient improved students' self-reported confidence in breast history taking.⁶³

2.6.4 Evaluation of Virtual Patients

Virtual Patients vary considerably in terms of quality, purpose, presentation and usability. Although the review of e-learning material should not differ from

evaluation of traditional modes of teaching, Ruiz suggests that evaluating e-learning material requires consideration of additional dimensions.⁶⁴

The Association of American Medical Colleges MedEdPORTAL project is a web-based tool that promotes collaboration across disciplines and institutions by facilitating the exchange of peer reviewed educational material.⁵⁶ The Association adopted Glassick's six criteria to help evaluate e-learning material, such as Virtual Patients:⁶⁵ (Table 2.6.4)

Table 2.6.4 Glassick's six criteria

Number	Criteria	Explanation
1	Goals	Intended target/audience is identified The author's description of this material is accurate and up-to-date The author's description of the material includes clear goals or statement of purpose
2	Preparation and content quality	Content is accurate and up-to-date throughout the material Citations, references, credits and/or links are relevant Citations, references, credits are complete
3	Methods: effectiveness of material	Instructional/assessment methods are appropriate for the stated goals/objectives Multimedia (e.g. Videos) is effectively used Learning activities are used effectively (e.g. Learner control, navigation) Feedback is used effectively Methods maintain learner dignity
4	Presentation and ease of use	Material is easy to use Content is clear and well organized Video quality is good Audio quality is good Image/illustration quality is good The material offers effective help functions The quality of the specimens is good (adequate staining, adequate specimen, preparation etc.) Material is engaging Application loads, launches and executes smoothly (the material appears to have no bugs)
5	Significance	Material offers an innovative learning/teaching method Evidence of product effectiveness is provided Documentation describes how the material builds on prior work Material contributes to the field Material can be customized to fit a range of curricula/courses
6	Reflective critique	Documentation includes lessons learned, future directions or suggestions for adaptations or extensions Documentation provides sufficient information to guide others in using the material(s)

A review by Cook et al. in 2009, highlighted the huge variation in existing Virtual Patients, which impacts on learning and assessment.⁵³ Recognised feature variations, which need to be considered, include:

- The level of interactivity?

- How clinical information is requested and how responses are provided?
- How the case progresses?
- How are cases organised and selected?
- How and when does feedback and instruction occur?
- What instructional strategies are employed?
- Do learners collaborate or complete cases alone?
- Is the Virtual Patient integrated into the curriculum?
- Is assessment performed?
- How are cases developed and maintained?

Following a review of the literature, the authors concluded that ‘Virtual Patients are likely to play an increasing role in medical education in coming years. However, their effective use requires evidence to guide design and integration. This evidence base is currently virtually non-existent’, ‘educators have little guidance in how to develop effective Virtual Patients’.⁵³

In 2009, Huwendiek et al., recognising the huge variation in the form, function and efficacy of different Virtual Patients, empirically derived a Virtual Patient design framework to provide a common reference point for people wishing to study Virtual Patients.⁶⁶ The authors describe 19 factors centred around 4 categories: general, educational, instructional design and technical components.

A more recent systematic review and meta-analysis sought to gain a better understanding of the effectiveness of Virtual Patients in health professional training. Cook et al. found that Virtual Patients, in comparison with no interventions, were consistently associated with better learning outcomes. However, the pooled effect-size for studies comparing Virtual Patients with non-computer interventions was not significant.⁶⁷

2.6.5 Design of Virtual Patients

In the literature, numerous types of Virtual Patients have been described and recognised patterns are now emerging. However, to date, there has been little study

of the permutations of Virtual Patient design.⁵³ Little is known about what design features promote student learning. However, Ellaway describes five distinctive designs, which have been employed in the development of virtual patients:⁵⁴

Linear-passive: Linear Passive Virtual Patients are similar to problem-based learning or case based discussions. This form of Virtual Patient can be used as a stimulus for small group discussions. Although the single predetermined pathway may not engage the students in the same way as a more complex, multi-choice scenario, it can trigger discussion and reflection.

Linear Interactive: The commonest type of Virtual Patient is the Linear Interactive case, which allows students to select available options such a diagnosis or treatment before they can then move on to the next stage. Feedback is based on the choices made, time taken, and success (or otherwise) in completing the problem.

Branching: Branching Virtual Patients are based on a tree of possible options. Students select the best available option at each stage of the case. Feedback is based on the choices made, the time taken and success in completing the problem. This helps students develop clinical reasoning skills by making choices and observing the consequences of their decisions. This form of Virtual Patient helps mimic real life clinical decision-making and gives students the opportunity to take different paths depending on which choices they make.

Student-authored: In student authored Virtual Patients, the students actually create the Virtual Patient. This method can help students gain a deeper understanding of patient-physician encounters and can prove a useful method for generating many cases.

Knowledge base contextualisation: In this design, the Virtual Patient is used as a vehicle by which a knowledge base (such as a textbook, guideline or wiki) is presented and contextualised through one or more clinical encounters.

Huwendiek et al. used focus group discussions to examine what students perceive as the ideal features of Virtual Patient design in order to foster learning with a special

focus on clinical reasoning. Participating students viewed four differently designed Virtual Patients. Ten principles of Virtual Patient design emerged from analysis of the focus group transcripts.⁶⁸ (Table 2.6.5)

Table 2.6.5 Huwendiek's ten principle of Virtual Patient design

Number	Principle	Explanation
1	Relevance	Students preferred Virtual Patients which covered problems that they were unlikely to encounter in clinical practice and were relevant in terms of incidence and seriousness
2	Appropriate level of difficulty	The level of complexity should be appropriate for the students' knowledge base
3	Interactivity	Virtual Patients should be highly interactive and use a variety of question formats
4	Specific feedback	Students wished to receive feedback on their decisions
5	Appropriate use of media	Different media should be used to make Virtual Patients as realistic as possible
6	Focus on relevant learning points	Text should be kept to a minimum and important learning points highlighted
7	Recapitulate key learning points	At the end of the Virtual Patient module students should be evaluated on what they have learned and key take home messages should be provided
8	Authenticity of the web based interface	The web-based interface should be authentic so that the student feels like they are the doctor
9	Authenticity of student tasks	Students should have to make the same decisions that a doctor would have to make in real life
10	Questions and explanation	Students should be encouraged to actively participate in the clinical reasoning process

Botezatu et al. conducted focus groups to explore student perspectives on an explorative interactive virtual patient simulation module designed to foster clinical reasoning skills.⁶⁹ They identified 18 categories which were subsequently clustered into 5 different themes; learning, teaching, assessment, authenticity and implementation. The authors concluded that although medical students perceive Virtual Patients as important learning and assessment tools, certain design features must be met. Cases should be widely accessible and reflect the reality of clinical practice with realistic menu options for history taking, physical exam and diagnostic tools.

2.6.6 Categories of Virtual Patients

Virtual Patients can be categorized into two main groups: Problem Solving Virtual Patients and Narrative Virtual Patients. Problem solving Virtual Patients are aimed at fostering the skills of clinical reasoning and diagnosis. The student gathers the information either in the form of physical findings on examination, laboratory tests, radiographic tests etc. and uses this information to then diagnose, manage and treat the Virtual Patient. Cook et. al., argue that the development of reasoning skills is the forte of Virtual Patients.⁵³ In contrast, narrative Virtual Patients are concerned with cause and effect. As templates cannot be used, they are more expensive to develop. However, they are more 'humanistic' and many studies support their use. A study by Bearman et. al. in 2001 assessed how the learning experience of students can be influenced by the type of Virtual Patient design used in the teaching of communication skills.⁷⁰ Although the results were inconclusive, the authors found some evidence to support the use of a narrative Virtual Patient design. However, although they acknowledge that there is little evidence to support the impact of any kind of Virtual Patient on student behaviour, the authors encourage developers to consider the narrative design approach in the creation of any Virtual Patient that seeks to replicate human interaction.

2.6.7 Virtual Patients and assessment

Students are guided and motivated in their studies by the types of assessments that are employed.⁷¹ The potential advantages of using computers in medical education are well recognised since the 1960s.⁷² In particular, multimedia capabilities can offer a safe learning environment for case-based evaluation of medical students.⁷³ Assessment Virtual Patients or AVPs are one of the emerging developments in computer-based assessment. They allow examiners to test knowledge and permit the assessment of interpretation and decision-making skills in the context of a patient scenario.⁷⁴ Although simulated patients and Virtual Patients are increasingly used in assessment, there is little research on their use.

Round et al. describe 3 levels of AVP with increasing complexity. Level 1 AVPs are composed of a series of multiple choice questions centered round the presentation,

assessment and management of a clinical case. Level 2 AVPs adapt to candidates' ability by adjusting the difficulty of questions according to responses. Finally, in level 3 AVPs, the patient's condition changes in response to decisions made by the candidate.

Gesundeheit et al. used Likert scales and focus groups to explore students' experiences of a Virtual Patient exam compared to an exam with a standardized patient.⁷⁵ Students' acceptance of the Virtual Patient for teaching and assessment was high. Students reported that the Virtual Patient case was 'more realistic' than a traditional standardized patient because standardized patients do not produce physical findings.

In 2008, Waldmann et al. assessed the reliability and validity of an online General Practice Virtual Patient assessment tool. Due to weaknesses in study design, the authors were unable to demonstrate convincing evidence of validity.⁷⁶ Similarly, a pilot study by Courteille et al., which attempted to assess the use of a virtual patient case in an OSCE based exam, was methodologically flawed and failed to produce convincing evidence for the use of Virtual Patients in assessment.⁷⁷

2.6.8 Conclusion

Virtual Patients have now begun to enter the mainstream of medical education. Several advantages of the use of Virtual Patients have been identified. However, the cost of developing Virtual Patients limits their potential use. Although Virtual Patients are still a heterogeneous group of learning resources, various patterns, categories and features to guide their development are emerging from the literature. It is still not clear what design features promote the most effective learning. Although Problem-solving Virtual Patients are the commonest category being developed, narrative Virtual Patients are understudied and could have an important role to play in teaching about cause and effect and the nature of human interaction.

2.7 Virtual Patients and learning

2.7.1 Role of computer based learning

Computer based learning can potentially offer a means of reproducing some of the important aspects of work-based learning within a safe environment. Multimedia learning tools, also referred to as computer aided instruction (CAI) or computer-based learning (CBL), are programs that use computers to combine text, graphics, audio and video into a concise presentation.⁷⁸ The application of computer tools in teaching is one of the most prevalent themes in the current medical education literature⁷⁹ and can offer opportunities for ‘social participation’, albeit in a virtual environment.

In academic institutions internal and external drivers are pushing the development of sophisticated multimedia software programs to support learning. However, Clarke argues that media are ‘mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition’.⁸⁰ In order to use the potential educational benefits of multimedia tools, they need to be viewed as much more than just another means of transmitting information.⁸¹ Schramm et al. propose that we need to focus, not just on the type of medium, but also on the contents and instructional strategy within the medium.⁸²

In order to create a constructivist computer-based learning environment, four key concepts of a constructivist environment must be met:

1. An engaged learner
2. Hands on interaction with the materials of the task
3. An authentic problem solving context
4. Human interaction during the learning process

In order to achieve this, an understanding of educational theory as it applies to multimedia learning is needed.

2.7.2 Dual-code theory

Allan Paivio from the University of Western Ontario first described the dual-code theory in 1971.⁸³ In attempting to give equal weight to both verbal and non-verbal processing, the theory posits that there are two cognitive subsystems, one for imagery and one for language. Although both systems are functionally independent, they are interconnected. According to Paivio, "Human cognition is unique in that it has become specialized for dealing simultaneously with language and with nonverbal objects and events. Moreover, language is peculiar in that it deals directly with linguistic input and output (in the form of speech and writing) while at the same time serving a symbolic function with respect to nonverbal objects, events and behaviours. Any representational theory must represent this dual functionality."⁸⁴

Paivio claims that visual and verbal information is processed differently along distinct channels within the human mind creating separate representations for information processed in each channel. According to the dual coding theory it would be better if more than one communication channel were used during learning. Indeed, a growing body of evidence now exists to support the contention that student learning is affected positively by presenting text and images together.⁸⁵

2.7.3 Cognitive theory of multimedia learning

During the past two decades, increasing attention has focused on the beneficial effects of using multimedia for learning. Richard Mayer proposed the Cognitive Theory of Multimedia learning, building upon Paivio's concepts. It is based on three assumptions derived from cognitive science research:

- Dual channels (people have separate systems for processing visual and verbal content)
- Limited capacity (people are able to process only a few elements in each system at one time)
- Generative processing (meaningful learning occurs when learners engage in appropriate cognitive processing during learning)

Working memory is assumed to be crucial in multimedia learning, because all information needs to be processed in working memory before it can be stored in long-term memory. Mayer argues that whenever you teach concepts with words, you should pair it with an associated picture in order to promote long term knowledge gain. According to Mayer, for meaningful learning to occur in a multimedia environment, the learner must engage in five cognitive processes:

- Selecting relevant words
- Selecting relevant images
- Organizing selected words
- Organizing selected images
- Integrating word and image based representations

Mayer concludes that these processes have important implications for multimedia design and, accordingly, he developed ten major principles to guide multimedia use:⁸⁶ (Table 2.7.3)

Table 2.7.3 Mayer's ten principles to guide multimedia use

Number	Principle	Explanation
1	Temporal contiguity	When giving a multimedia explanation, present corresponding words and pictures contiguously rather than separately
2	Coherence	When giving a multimedia explanation, use few rather than many extraneous words and pictures
3	Signalling	People learn better when important words are highlighted
4	Redundancy	People learn better from animation and narration than from animation, narration and on-screen text
5	Spatial contingency	People learn better when corresponding portions of the picture and printed words are near rather than far to each other on the page or screen
6	Segmenting	People learn better when a narrated animation is presented in learner-paced segments rather than as a continuous unit
7	Pre-training	People learn better when they have had training in the names and characteristics of the main concepts
8	Modality	People learn more deeply from animation and narration than from animation and on-screen text
9	Personalization	People learn more deeply when words are presented in conversational style rather than formal style
10	Voice	People learn more deeply when words are spoken in non-accented human voice rather than a machine simulated voice or a foreign-accented human voice

However, although there is greater acceptance and an increased use of computer based learning tools in medical, nursing and allied healthcare professional education, there are few studies exploring how multimedia learning tools can be used to support learning.⁹

Research has suggested both advantages and disadvantages of multimedia usage. In 1999, Lee Sing et al., in an effort to determine whether different media presentations of similar content affected content knowledge, digitalized segments of the National Geographic videotape 'Fusion: A work in Progress' to create a digital video format.⁸⁷ Participating students were assigned to one of three groups: (i) digital video presentation with text, (ii) audio-only presentation with text and (iii) static visual presentation with text. Participating students completed a post-program achievement

MCQ. The authors found no significant difference in achievement scores between groups. However, there were significant differences between groups in the length of time taken to view the program. The audio group took significantly longer than both the video and static visual group. The authors concluded that in the design of computer-mediated presentations, the comparative efficacy of the learning media might be more important than the effectiveness of media implementation.

Bowdish et al. investigated the effectiveness of applying Hypermedia Assisted Instruction Technologies (HAIT) to create a virtual problem-based learning case and they compared this to a text only based case. The authors found that students in the virtual case group performed better than the text-based groups on a written examination.⁸⁸

Sakowski et al. developed a web-based problem-centred series of case dealing with complaints and conditions commonly encountered in primary care. Students found the case to be an effective and efficient method of learning; no significant difference in performance on multiple-choice items dealing with the case was found between students who had completed the module and those who had received the traditional curriculum.⁸⁹

In order to determine whether critical thinking in problem-based learning groups differed according to case modality, Kamin et al. compared indicators of five critical thinking stages for third year medical students completing a PBL. Students were assigned to one of three groups: (i) face-to-face group with a text case, (ii) face-to-face group with digital video case, (iii) a virtual group with digital case. The authors found that video enhanced critical thinking in either face-to-face or virtual groups and concluded that video rather than text provides information to students in a more realistic format.⁹⁰

A study by Balslev et al. reported similar findings. These authors investigated whether adding a brief video case instead of an equivalent written text improves cognitive and meta-cognitive processes of paediatric residents in problem-based learning. They found that students who watched the video case showed statistically

significant improvements in data exploration, theory building and theory evaluation compared to students who only read a description of the video scenario.⁹¹

2.7.4 Multimedia learning tools

In order to maximise learning, students need to interact with the media being presented. Therefore, we need to move beyond video cassettes, CD-ROMs and DVDs to embrace an era where advances in technology allow us to integrate streaming video into interactive educational tools to support learning (multimedia-learning tools (MMLT)).

A review of interactive video-disc instruction, applied in defence training and education by Fletcher in 1990, found that academic achievement was improved in all settings when interactive video was used. Video was more effective when more interactive features were used and was effective for knowledge and performance outcomes.⁹² Fletcher reported that students retain just 20% of what they hear, 40% of what they see, but 75% of what they see, hear and interact with.

However, merely using interactive videos in curriculum delivery does not take advantage of the diversity of this medium and how instructional methods can be used to support learning through media. According to Mayer, 'technology does not cause learning, but rather instructional methods cause learning.... Overall it is not fruitful to ask whether one particular technology is better than another.... It all depends on how they are used and what is the instructional method'.⁹³

2.7.5 Cognitive load theory

Cognitive load theory proposes that, because working memory or short-term memory is limited, learners may become overwhelmed by information if its complexity is not properly managed. Schemata are cognitive constructs that permit people to categorize information in the manner in which it will be used.⁹⁴ According to Sweller, cognitive overload impairs schema acquisition and results in lower performance.⁹⁵ There are three types of cognitive load, intrinsic, extraneous and germane. 'Intrinsic load is the mental work imposed by the complexity of the

content'⁹⁶ It is 'imposed by the basic characteristics of the information rather than by the instructional design'⁹⁷ i.e. how difficult the subject matter is. Material that contains a large number of elements, which interact with one another, is considered difficult, whereas a small amount of material composed of single or isolated elements is considered easy. Intrinsic load also depends on the learner's prior knowledge or experience of the subject matter.⁹⁸ Extraneous load is imposed by the instructional material, which does not directly contribute to learning, i.e. load which is not necessary for learning and can be modified by instructional interventions. Finally, germane load is the remaining free capacity in working memory or the load imposed by processes such as interpreting, classifying, inferring, differentiating and organizing.⁹⁹ In order to develop effective multimedia learning tools, a balance is needed between these three components. It can be difficult to entertain and engage students in multimedia learning while, at the same time, ensuring that the tool remains free of elements that are potentially distracting or contributing to extraneous load.⁷⁸

Measuring cognitive load is difficult. Paas et al. describe three ways in which cognitive load can be measured: (i) self-ratings through questionnaires, (ii) physiological measures and (iii) secondary tasks.¹⁰⁰ However, these measures have not been able to differentiate between the three cognitive load components.

Cognitive load theory has contributed greatly to educational design. De Jong summarises the three main recommendations that come from cognitive load theory: (i) present material that aligns with the prior knowledge of the learner (intrinsic load); (ii) avoid non-essential or confusing information (extraneous load) and (iii) stimulate processes that lead to conceptually rich and deep knowledge (germane load).¹⁰¹

Eva et al. attempted to delineate ways in which better instructional multimedia programs can be developed by employing the seven strategies believed to characterize effective clinical teaching.¹⁰² Grunswald et al. adapted these characteristics to create a list of guidelines to help educators create cognitively effective multimedia learning tools.⁷⁸ (Table 2.7.5)

Table 2.7.5 Grunswald's guidelines for creating cognitively effective multimedia learning tools

Number	Guideline
1	Create active, self directed learners
2	Involve students in agenda planning and goal development
3	Adopt an authentic context
4	Provide student-sensitive instructional feedback
5	Provide a student-sensitive environment
6	Promote goal reflection
7	Synchronize audio and visual information
8	Eliminate multitasking
9	Optimise representations and design and approachable interface
10	Maintain a stable learning environment
11	Eliminate redundant information
12	Optimise navigational control

2.7.6 Conclusion

Multimedia techniques are more than just another means of transmitting information. In order to ensure that, as educators, we facilitate meaningful learning, we need to focus attention on the type of instructional methods used. The dual-code theory has many implications for teaching and learning and leads us to anticipate differences in outcomes between cases that are presented as video and as text. Few studies have empirically tested how working memory for multimedia learning contributes to learning from texts and pictures and even fewer have studied the use of video. The literature indicates that there are several advantages to the use of videos as an educational resource, especially if the student is provided with opportunities to interact with the media.

2.8 Professional development

2.8.1 Introduction

It can be argued that, in the past, too much emphasis was placed on simply acquiring scientific knowledge and we failed to emphasize other important dimensions such as the professional characteristics of empathy, compassion and integrity.⁹ However, we

now see a focus on developing important humanistic skills such as communication and professionalism and a move away from just treating the disease or symptom to focussing on the whole patient. In recent years, the issue of medical professionalism has become topical and continues to receive attention at both undergraduate and postgraduate level.^{103,104,105,106}

2.8.2 Definition of professionalism

Professionalism can be defined as the means by which individual doctors fulfil the medical profession's contract with society.¹⁰⁷ A profession is *'an occupation whose core element is work, based on the mastery of a complex body of knowledge and skills. It is a vocation in which knowledge of some department of science or learning, or the practice of an art founded on it, is used in the service of others. Its members profess a commitment to competence, integrity, morality, altruism, and the promotion of the public good within their domain. These commitments form the basis of a social contract between a profession and society, which in return grants the profession autonomy in practice and the privilege of self-regulation. Professions and their members are accountable to those served and to society.'*¹⁰⁸ Thus, "professionalism" denotes the standard of behaviour that individual physicians are expected to meet as they provide care to patients and it is the basis of medicine's contract with society. In essence, it is the profession's commitment to a common set of ethics, values and principles that puts patients first.¹⁰⁹

There are many definitions of professionalism from a large number of organizations that have made an effort to place a stronger emphasis on returning professionalism to the vocation of medicine. Although numerous organizations, including the American Association of Medical Colleges,¹¹⁰ the American Board of Internal Medicine,¹¹¹ the Accreditation Council for Graduate Medical Education,¹¹² the National Board of Medical Examiners¹¹³ and the Liason Committee on Medical Education¹¹⁴ have attempted to define what they consider to be the core components of professionalism, perhaps the most widely cited list is that of the American Board of Internal Medicine (ABIM): Project Professionalism.¹¹¹ The Board, recognizing that major changes were taking place in the practice of medicine and that public trust in the profession appeared to be diminishing, explicitly addressed the need to promote professionalism

in medical education and defined professionalism as being composed of three commitments and six elements:

Commitments:

- The highest standards of excellence in the practice of medicine
- Sustain the interests and welfare of patients
- Be responsive to the health needs of society

Elements:

- Altruism
- Accountability
- Excellence
- Honour
- Integrity
- Respect for others

In 2005, the Royal College of Physicians in the UK launched an inquiry into the meaning of professionalism. It concluded that professionalism is ‘a set of values, behaviours, and relationships that underpins the trust the public has in doctors. It requires doctors to work together with patients, to exercise honesty, empathy, confidentiality, humanity and above all judgment in the face of uncertainty’. The report ‘Understanding Doctors: Harnessing Professionalism’¹¹⁵ highlighted the most important aim of professionalism as securing trust.

In Ireland, there has been a similar effort to emphasize the importance of professionalism. The Irish Medical Council defines professionalism as ‘the set of values, behaviours and relationships that underpins the trust the public has in doctors and recommends that it be visibly integrated throughout the curriculum. Professionalism includes the recognition and maintenance of the well-being and dignity of individual patients, commitment to the highest standards of patient care, motivation to serve the needs of the community, recognition of the importance of continuing medical education, and awareness of the ethical principles and the medico-legal basis of practice.’ In a Review of Medical Schools by The Irish

Medical Council in 2007, the Council recommended that all medical schools should enhance the role of professionalism in the undergraduate curriculum.¹¹⁶

2.8.3 Threats to professionalism

Medical professionalism is threatened, not just by factors arising from within the profession itself, but also by external environmental factors outside of the control of the profession.^{117,118} Van Mook et. al. define three current threats to professionalism: self interest, peer pressure and commercialism.¹¹⁹ Buyx et. al. summarize what they describe as the 'acute threats to the republic of medicine as a profession'. Included in the list of threats are: increasing concerns that doctors now routinely put self-interest above patient interest; the perception that medical education fails to support the development of professionalism; worries that doctors are frequently unwilling and lack the ability to understand and apply the findings of modern medical research.¹²⁰ Both Starr and Stevens raise concerns that the public now perceive members of the profession as becoming less altruistic.^{121,122} Overall, the medical profession is now seen as being less altruistic, as abusing its privileged position and as failing to self regulate.

It is clear that in recent years public trust in the medical profession is diminishing and with it trust in the doctor-patient relationship.^{107,123,124} Internationally, the cases of Michael Swango, Harold Shipman and the Bristol Royal Infirmary at Alder Hey Hospital have led the public to believe that medicine has protected incompetent or unethical doctors in the name of collegiality. If we look at our own national headlines we can see numerous examples of doctors losing touch with their fundamental commitment to medical professionalism and a number of high profile cases have damaged the reputation of the profession in Ireland.

2.8.4 Professionalism and the doctor patient relationship

Professionalism is recognized as having a major influence on the doctor-patient relationship.^{125,126} The doctor-patient relationship is a privileged one that depends on the patient's trust in the doctor's professionalism. Studies have shown that professionalism is related to patient satisfaction. A study by Pichert et. al. concluded

that 20% of patient dissatisfaction with doctors was due to poor communication skills and 10% arose from some form of perceived disrespect.¹²⁷

Loss of trust in the profession can also affect patient compliance with treatment. There is evidence to suggest that patients are more likely to comply with treatment recommendations when they trust their doctor. Hauck et. al., conducted a survey of 185 randomly selected patients from a family practice in order to see whether health outcome variables were related to physician humanism. He found greater success in patients' attempts to quit smoking was associated with higher physician humanism.¹²⁸

There is increasing evidence that unsatisfactory performance in clinical practice is more likely to be due to unprofessional behaviour, rather than lack of knowledge or skills. Indeed, some authors estimate that over 70% of malpractice suits against the profession are due to poor communication by doctors.¹²⁹ Therefore, patients are more likely to bring legal action against doctors they perceive as behaving unprofessionally.

2.8.5 Professionalism and undergraduate medical education

Historically, it was assumed that medical students who were competent in the biomedical sciences would learn the values of professionalism through clinical experience and role modelling. However, it is now becoming clear that undergraduate medical training can no longer rely on mentoring and clinical experience to teach professionalism.^{130,131}

Creuss argues, as we are no longer 'a relatively homogenous medical profession serving a similarly homogeneous society', we need to explicitly teach professionalism.¹³² Cohen et. al. state that if medicine and its practitioners are to prevail against threats to the profession, we must assume greater responsibility and accountability for ensuring that the next generation of doctors will sustain their commitment to the ethics of professionalism.¹⁰⁷ Cohen states that, in order to accomplish this, medical schools and teaching hospitals need to address three broad areas:

1. Improve the selection of future doctors

2. Improve the formal instruction to their learners and teachers
3. Purge their own learning environments of unprofessional practice

Hilton et. al. argue that in order to facilitate medical professionalization, medical educators need to:

1. Recognize that professionalism arises from a long term combination of experience and reflection on experience
2. Provide stage-appropriate experiences for the development of professionalism
3. Maximize opportunities for attainment and minimize inappropriate attrition¹³³

The on-going advancements in science and technology, the increasing complexity of health care systems and the difficult challenges to the profession, both internal and external, make this a particularly challenging and often uncertain time for students entering the profession. Students learn in a competitive environment, often with limited availability of role models and mentors and a curriculum that focuses primarily on the attainment of clinical knowledge and skills. Studies have shown that the values and ideals consistent with the principles of professionalism which students articulate when they enter medical school often decline over the course of their clinical training.¹³⁴

A study by Eron et. al. in 1995 found that, over the course of their training, students' cynicism increased and humanitarianism decreased. Eron defined cynicism as 'A contemptuous disbelief in man's sincerity of motives or rectitude of conduct, characterized by the conviction that human conduct is suggested or directed by self interest or self-indulgence'.¹³⁵ Testerman et. al. describe two different models to explain how this shift from altruism to cynicism occurs. The 'Professional Identity' model describes how the 'harsher' components of professional socialization cause medical students to become cynical over the course of their undergraduate medical education. Testerman describes this as a 'temporary by-product', an adaptation state, which reverses or minimizes, as the students become senior practicing physicians. The second model, which he suggests, is the 'intergenerational transmission' model, which describes cynicism as a learning response. Students learn to adopt the same

cynicism they witness in doctors or faculty members who are abusive or cynical themselves.¹³⁶

Some studies indicate that doctors who act unprofessionally are likely to have demonstrated early indications of unprofessional behaviour during the course of their undergraduate training. A case-control study by Papadakis et. al. published in 2005 found disciplinary action against practicing physicians was strongly associated with prior unprofessional behaviour in medical school.¹³⁷ The authors concluded that professionalism should have a central role in medical education and supported the importance of identifying students who display unprofessional behaviour.

2.8.6 How to teach professionalism

Medical schools have long debated how to teach professionalism to medical students. Although the key concepts of professionalism are well described in the literature, institutions still struggle with how to teach these core professional values effectively and efficiently. Wagner et. al. describe the teaching of professionalism as ‘one of the most difficult core content areas in medical education’.¹³⁸ Although the development of core professional values is a developmental process, undergraduate medical education represents the first critical step in the process.

Medical undergraduate teaching has traditionally focused on how best to teach knowledge and skills, and has failed to recognize effective curricular approaches to teaching professionalism.^{139,140} As such, there is no uniform consensus on how professionalism should be integrated into the undergraduate curriculum, although it is now recognized that didactic teaching alone is insufficient for the teaching and learning of professional values. A study by Roberts et. al. found that only 18% of over 300 medical students and psychiatry residents described their professionalism training as adequate.¹⁴¹

As late as the 1970s, the formal teaching of professionalism, humanism and ethics was not part of the medical school’s curriculum. Currently, however, Personal Professional Development has assumed a major place in the medical educator’s agenda and indeed nearly all medical schools in the US now include some formal

instruction in professionalism.^{142,143} A Personal Professional Development curriculum is classically composed of five interrelated elements: communication skills, humane care, self care, ethics and health law and medical humanities.¹⁴⁴ A study by Swick in 1999 showed that 104 out of 116 medical schools in the US provide some type of formal curriculum content related to professionalism and professional values.¹⁴² Medical schools have an obligation to ensure that their educational programmes are designed explicitly to nurture the development of professional values.¹⁰⁷ Professional development must therefore become part of the core undergraduate curriculum.¹⁴⁵

It is evident by the growing body of literature, mainly from the United States, that there has been a trend towards greater integration of professionalism into the formal curriculum.¹⁴⁶ The teaching and assessment of professionalism is now recognized, not as an isolated component of the curriculum, but an integral part of all undergraduate teaching.

Professional development is a process which extends from medical school right through to clinical practice.¹⁴⁷ Rudy et. al. contend that the development of professional skills should begin early in medical training.¹⁴⁸ They argue that it is possible to develop what they describe as a 'stage appropriate' curriculum which can begin to teach professional skills and behaviours to medical students as early as the pre-clinical years. Wear and Castellini argue that effective teaching of professionalism requires an intellectual widening of the medical curriculum, so students are given the opportunity to acquire the skills and tools necessary for professional development throughout their training.¹⁴⁹

The teaching of professionalism must become a core component not just of the medical undergraduate curriculum but also of postgraduate training. Cruess states this will help ensure the 'growth of both explicit and tacit knowledge of professionalism will take place in parallel with growth of knowledge in other areas'¹³² Hilton et. al. describe this developmental process as an 'acquired state... one that takes a number of years to attain and which must be maintained throughout a professional lifetime'.¹³³ They suggest the introduction of a new term 'proto-professionalism' to describe how professionalization and learning occurs across the continuum of medical education.

Although the importance of the informal and hidden curriculum cannot be overlooked, the formal curriculum should not be discounted as an important contributor to professional development. As Stephenson et. al., state that ‘The learning environment, both hidden and formal, must support rather than undermine the development of professional qualities’.¹⁴³ Van Mook et. al., argue that increasing time spent in a formal course in professionalism is associated with increased satisfaction with professionalism training, although clinically orientated teaching and informal discussion are still considered to be important and highly valued.¹¹⁹ He calls for more pro-active educational programs in professionalism. Indeed, Stephenson et. al., conclude that a commitment to formal curriculum reform and broader approaches to the teaching of professionalism is the key.¹⁴³

The commonest means of teaching professionalism in the formal undergraduate medical curriculum are:

- Courses
- Workshops
- Specific modules
- Problem-based learning sessions¹⁵⁰
- Role plays and simulated patients¹⁵¹
- White Coat Ceremonies

The white coat is one of the most recognizable symbols of the medical profession. White Coat Ceremonies are now becoming commonplace in many North American medical institutions.¹⁵² During this annual ceremony students entering medical school are welcomed into the profession. Each student is presented with a white coat in a robing ceremony, which is then followed by the students’ proclamation of their professional commitment, either the Hippocratic Oath or a similar oath of professionalism.¹⁵³ Although White Coat Ceremonies are becoming more common, and have been adopted by over 93 US medical schools, Branch stresses that White Coat Ceremonies alone are inadequate to support the professional, moral and ethical development of students and that they are only a single component of what is actually needed.¹⁵⁴ More recently, colleges have experimented with courses in the

history of medicine, which emphasize to students how the concept of medical professionalism evolved. Cruess supports the development of courses, which help students understand the historical roots of professionalism and its relationship to medicine's social contract with society.¹³² Some institutions use small group case based discussions to explore both professional and unprofessional behaviour while others give students the opportunity to follow patients with chronic illnesses over the course of their training in order to highlight the importance of the doctor-patient relationship.

Although there has been a wealth of literature published on current efforts to incorporate professionalism into the undergraduate curriculum and the methods used to teach it, Stephenson et. al., conclude in their review of 'Teaching Professional Development in Medical Schools' as follows: 'A commitment to formal curriculum reforms and broader reaching approaches to the teaching of professionalism is needed.'¹⁴³

Several recommendations were put forth regarding the assessment of professionalism from the Ottawa 2010 Conference.¹⁵⁵ From three overarching discourses about professionalism assessment, eight general principals relating to the assessment of professionalism were developed. The authors concluded that further research on the assessment of professionalism is needed and proposed a number of recommendations for future research:

- Examine the concept of professionalism and its assessment across different linguistic and cultural contexts
- Compare the definitions and conceptions of professionalism assessment in medicine to those held by other healthcare professions
- Characterize which elements of professional behaviour are amenable to learning (and therefore remediation) and which may have a more immutable quality that are amenable to selection processes
- Examine links between the assessment of professionalism and other assessment initiatives such as quality of patient care
- Develop and evaluate means of incorporating patients' perspectives into the assessment of professionalism

- Explore professionalism assessment in complex clinical workplaces, including how individuals adapt to difficult or even dysfunctional systems and the gaps that arise between espoused values and actual practice
- Elaborate ways that assessment data can be used to change the culture of education and practice, in particular the *hidden curriculum*
- Consider what happens when expectations at an individual level conflict with those at the societal/organizational/institutional level, and what the resolution means for professionalism assessment
- Explore innovative ways to collect and analyse quantitative and qualitative methods of assessment data from mixed-methods approaches, paying particular attention to threats to validity inherent in different assessment methods
- Conduct outcome studies to examine the impact of curriculum (formal, informal and hidden) and other organizational interventions related to professionalism

2.8.7 Professional dilemmas encountered by students and trainees

In order to inform curricula, numerous studies have sought to gain an understanding of professional dilemmas or ethical issues experienced by students and trainees. Hicks et al. surveyed medical students to gain an understanding of the prevalence and nature of their ethical dilemmas. The authors identified three types of ethical dilemma characteristic of early clinical training:

1. Conflict between medical education and patient care
2. Responsibilities exceeding students' capabilities
3. Involvement in care perceived to be substandard.¹⁵⁶

As a result of the study, the University of Toronto and its affiliated teaching hospitals developed guidelines for the teaching of ethics.

In order to gain an understanding of the required contents of a clinical ethics curriculum, Huijjer et al. analysed case reports on ethical dilemmas experienced by

interns.¹⁵⁷ They identified four recurring themes that are not adequately dealt with during preclinical courses.

1. Disclosure or non-disclosure of information to patients and informed consent
2. Medical decisions at the end of life
3. Medical failures
4. Problems transferring patients from one caregiver to another

The authors also identified 27 themes linked to the interns' unique position and recommended that the contents of ethics courses should be more aligned with these ethical dilemmas.

2.8.8 “Cinemeducation” and professionalism

“Cinemeducation” refers to the use of entire movies or shorter video clips from movies to teach trainees and medical students about the psychosocial aspects of medicine. Video clips from movies can help generate group discussion, role-play, emotional responsivity and self-reflection.¹⁵⁸ Since the 1950s, there have been at least 70 medically themed television programs many of which have also been shown to have pedagogical value.¹⁵⁹

In the early 1990s, Alexander described how video clips from the movie *The Doctor* could be used to teach residents and students about interviewing skills, delivering bad news, the psychosocial impact of terminal illness, balancing work and home, cross-cultural issues, hospital bureaucracy, patient satisfaction and safety and effective residency education. Although no formal evaluation was undertaken, the author hypothesised that teaching through video clips enabled students to understand more readily the teaching points.¹⁵⁸

Since then, there have been increasing reports in the literature of the use of videos as teaching aids in various specialties and support of the idea that video is an innovative and effective means of teaching.^{160, 161} Videos can expose learners to situations they

might not otherwise encounter.¹⁶² Indeed, Parkin et al. found that videos can both stimulate and motivate students.¹⁶³

McNeilly and Wengel used scenes from the popular television series 'ER' to teach communication skills to medical students completing their psychiatry rotation.¹⁶⁴ The video clips that were chosen portrayed patients with different personality disorders and physicians breaking bad news to patients. After viewing the clips students participated in a facilitator-led discussion. Participating students completed pre- and post- seminar questionnaires and the authors found students' knowledge of and attitudes to countertransference, boundary setting and breaking bad news improved significantly.

Weber and Silk designed an elective exercise using a variety of films to help students understand how illness affects not only the patient but also the entire family. Although no rigorous evaluation was performed, the authors report that participating students, who completed an evaluation survey, responded positively to the elective.¹⁶⁵ The use of videos or movies to teach professionalism is well described in the literature. In the early 1990s, Self et al. used short films to teach medical ethics. Although the study was methodologically flawed, the authors demonstrated that students who viewed the films showed statistically significant increases in moral reasoning post-test scores.¹⁶⁶ Ber et. al., who have over 20 years experience with the use of trigger films ('short situational videotaped encounters between patients and/or families and medical staff'), found that trigger films are useful tools to stimulate open ended discussion on medical ethics and the rules of professional behaviour.¹⁶⁷

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Lumlertgul et al. used five movies, which depicted different professional issues, to promote professionalism in a 'Medical Ethics and Critical Thinking' course. The five themes explored were: the doctor-patient relationship, informed consent, clinical trials in patients, management of genetic disorders, patient management and brain death and organ transplantation. After viewing the movie, students participated in a student-led group discussion to explore professional issues. The authors found their 'Cinemeducation Project' to be an effective and entertaining method of facilitating the learning of professionalism for students.¹⁶⁹

However, there are limitations to the use of either movies, video clips of movies or television shows as teaching tools. In order to stimulate public interest and ensure high ratings, true representations of hospital practice are often compromised in the interest of cliff-hanging plots, which frequently violate ethical and professional codes, and create medical miracles and clinical inaccuracies. Therefore, educators must proceed cautiously if they are to use these videos as depictions of normal medical practice. Even if their usage is tightly regulated in a controlled learning environment, the potential for misinterpretation and acceptance of fictitious characters and plots as reality remains.

2.8.9 Assessment of professionalism

Despite publication of numerous articles describing various approaches to the assessment of professionalism, the development of reliable measures remains challenging. However, assessment is necessary in order to determine whether educational interventions are achieving their goals i.e. helping students develop their professional identity. Ginsburg argues that the assessment of behaviours may be the ultimate focus for the assessment of professionalism.¹⁷⁰ However, in daily clinical practice the logistics of assessing individual students' professional behaviour becomes overwhelming, as increasing student numbers and limited staff resources make reaching the peak of Miller's pyramid unfeasible.¹⁷¹ Recognising this barrier to assessing professionalism, Shubert et al. argue that a more practical and economical solution may be assessing students' professional behaviour through the use of case-based formats or vignettes.¹⁷² Several studies have used this approach by assessing students' response to ethical dilemmas. However, to date, there is no uniformly accepted, valid and reliable instrument available to measure responses to professional or ethical dilemmas.

One of the difficulties is that abstract ideals and principles do not map easily onto behaviours and it can be difficult to apply a shared standard of what constitutes professional behaviour in any given situation.¹⁷³ Goldie et al. used written vignettes to develop an instrument to assess and evaluate the learning of medical ethics. Inter-rater reliability was low, at just 0.37, and the authors failed to demonstrate the reliability of the instrument, despite providing intensive rater training.¹⁷⁴ Ginsberg et

al. used five scenarios in either video or text to gain an understanding of students' response to professionally challenging situations. Again, the authors were unable to demonstrate inter-rater reliability in scoring students' responses. The authors concluded that professionalism is a subtle and complex construct that does not reduce well to simple, single-scale dimensions.

Boenink et al. used vignettes describing a dilemma concerning professionalism to determine if educational sessions could improve students' knowledge of professional norms. Although a positive effect was found, students did not generalize their knowledge to new vignettes.¹⁷⁵ The authors speculated that lack of general professional rules and case specificity may have accounted for the lack of generalization.

2.8.10 Conclusion

Professionalism, regardless of which definition is used, is essential in order to maintain a strong and healthy doctor-patient relationship. However, professionalism is under threat from internal and external sources. Both students and doctors experience professional dilemmas and need skills and expertise to respond appropriately to difficult situations. It is now recognised that the teaching and assessment of professionalism should be explicitly addressed in the undergraduate medical curriculum. However, studies indicate that professionalism is a difficult construct to both teach and assess. The teaching of professionalism should be integrated into the undergraduate curriculum and not addressed as a stand-alone module. Videos can provide a means of addressing professional behaviour at undergraduate level. Creating a learning module, such as the Virtual Patient, that uses videos displaying professional dilemma scenarios may enable educators to both teach and assess professional behaviour while simultaneously enhancing clinical knowledge gain.

2.9 Reflection

2.9.1 Introduction

There is growing recognition of the need to encourage self-reflection in medical education.¹⁷⁶ Reflective capacity is considered an essential characteristic for professional competence. In 2003, the British Medical Council recognised the need to promote reflective practice at undergraduate level.¹⁷⁷

2.9.2 Definition of reflection

Many definitions of what constitutes reflection or reflective practice have been proposed. Both Dewey and Habermas contributed extensively to the concept of reflection and its role in teaching and learning. Although both educationalists argue that reflection serves to generate knowledge, they adopt different philosophical standpoints and present different frameworks. Dewey defines reflective thought as ‘active, persistent and careful consideration of any belief or supposed form of knowledge in the context of the grounds that support it and the further conclusions to which it tends’.¹⁷⁸ In essence, the process of reflection is a means of making sense of the world and promoting effective education. In contrast, Habermas focuses on the place of this process in the acquisition, development and consideration of knowledge as a means of promoting the empowerment of the individual.¹⁷⁹

Edgar Schon described reflection in two ways: reflection ‘in action’ and reflection ‘on action’. Reflection ‘on action’ involves looking back or reflecting after an event or experience has occurred. Reflection ‘in action’ is reflection while the event or experience is occurring.¹⁸⁰ Boud et al. argue that reflection is ‘a generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understanding and appreciation’.¹⁸¹ Regardless of which definition is used, reflection is an essential element in the experiential learning cycle. Experiential learning is the process by which learning occurs through experience. However, merely having an experience does not guarantee learning from that experience. In order for learning to occur, the experience must be integrated into

existing knowledge structures in order to construct new knowledge or build upon existing knowledge.

In 1984, Kolb described experiential learning as ‘the process whereby knowledge is created through the transformation of experience’.² Kolb described a ‘four-stage cycle of learning’ in which ‘immediate or concrete experiences’ provide the foundations for ‘observation and reflection’. In turn, these ‘observations and reflections’ are assimilated and distilled into ‘abstract concepts’. In the final stage, ‘active experimentation’, the new knowledge and skills are actively tested and the cycle can once again repeat itself. The key component of this cycle is reflection, the ability to look back and analyse experience in order to create new learning.

2.9.3 Doctors and reflective practice

Although it has gained increasing attention in recent years, reflection is not a skill that many professionals are comfortable using in clinical practice. The majority of doctors probably reflect ‘in action’, because we make adjustments as we are working, depending on the situation. However, reflection ‘on action’ is perceived as more challenging. Perhaps as Eraut states, it is because, as doctors, the work schedule is busy and ‘when time is extremely short, decisions have to be rapid and the scope for reflection is extremely limited’.¹⁸² Designing appropriate reflective activities and providing the necessary support and guidance to medical students is challenging because reflection is still uncommon in medical practice.

2.9.4 Guided reflection

There are various techniques designed to promote reflective practice. These include diaries, logbooks and portfolios. However, a review by Sanders published in *The Medical Teacher* identified only one study comparing different approaches to fostering reflection. The authors stressed the need for further research to compare different approaches to reflection and to include the use of new technologies.¹⁸³ Baernstein et al. conducted a randomised controlled trial that sought to determine whether writing, one-on-one interviews with faculty, or a combination of these, elicited reflection on professionalism in undergraduate medical students. Findings

indicated that students explored more professional issues during a 30-minute interview than during the writing exercise.¹⁸⁴

2.9.4.1 Johns' Model of Reflection

In 1984, Johns' proposed a 'guided reflection' method to assist in reflection on critical incidents or any general reflection on experience. He provided 5 cues to help practitioners access, make sense of and learn through experience:¹⁸⁵ (Table 2.9.4.1)

Table 2.9.4.1 Johns' Model of Reflection

Number	Cue	Explanation
1	Description of the experience	Describe the experience and what were the significant factors?
2	Reflection	What was I trying to achieve and what are the consequences?
3	Influencing factors	What things like internal/ external / knowledge affected my decision-making?
4	Could I have dealt with it better?	What other choices did I have and what were those consequences?
5	Learning	What will change because of this experience and how did I feel about the experience? How has this experience changed my ways of knowing? <ul style="list-style-type: none"> • Empirics: scientific • Ethics: moral knowledge • Personal: self awareness • Aesthetics: that art of what we do, our own experiences

Stark et al. used a modified version of this model to help students reflect on critical incidents. The authors concluded that guided reflection had a valuable educational impact on the exploration of professionalism.¹⁸⁶

2.9.5 Benefits of reflective practice

Studies have shown that reflection is associated with a more positive learning experience and with better examination performance.^{187,188} Stark et al. argue that

embedding reflection in the undergraduate course may encourage students to use it throughout their studies and career as part of work-based learning.¹⁸⁶

2.9.6 Engaging students in reflective practice

Despite its recognised advantages, engaging individuals in reflection is a persistent challenge to educators.¹⁸³ Little is known about the student characteristics that influence motivation to reflect. Grant et al. offered reflective learning techniques to year 3 undergraduate medical students (n=232). The 20 students who participated fully in the intervention found that reflective learning helped them select what they needed to learn and raised their awareness of their individual learning style. The authors concluded that, if these perceived benefits of reflective learning are to be taken up by a greater proportion of students, reflective learning needs to be better aligned with the curriculum and assessment.¹⁸⁹

2.9.7 Characteristics of reflectors

Although it is generally acknowledged that both genders should have equal reflective ability, the literature here is often contradictory. Carr and Carmody found no significant difference between males and females in the level of reflection achieved in written reflective summaries.¹⁹⁰ However, Boenink et al. found that female students gained higher scores compared to male students in a semi-structured questionnaire consisting of case vignettes designed to evoke reflection.¹⁹¹ In addition, the authors found no relationship between reflective capacity and age, but did find that reflection scores were higher among students considering general practice as a career.

Upon entry to medical school, graduate entry students have prior experience of tertiary educational models of learning and achievement. Having made the transition from pedagogical to androgogical learning, it is generally accepted that they are more mature than undergraduate medical students. In fact, they have been described as 'highly motivated and committed' and 'much more self directed, challenging, demanding, questioning and mature than undergraduate medical students'.¹⁹² A study by Fanning and Chadwick in 2010 aimed to assess the demographic and learning

attributes of graduate entry students. By using an abbreviated version of the Approaches and Study Skills Inventory for Students (ASSIST) and the Learning Style Questionnaire (LSQ), the authors found that the predominant learning style of graduate entry students is reflective.¹⁹³ Kember et al., who used a 16-item questionnaire to measure reflective thinking in undergraduate and postgraduate students, reported similar results. The authors found that postgraduate students were more likely to use deeper forms of reflection.¹⁹⁴

2.9.8 Assessment of reflection

A systematic review of reflection and reflective practice in health professional education by Mann et al. in 2009, identified nine studies that attempted to assess reflective capacity.¹⁹⁵ Eight studies were conducted at undergraduate level and included medical, dental therapy and nursing students. Most of the studies used questionnaires to assess students' reflection in learning. The remaining studies used detailed reflective journals or structured workbooks. The review concluded that the literature is still early in development and not conclusive, and that there is a need for more rigorously designed studies to evaluate the effect of different educational strategies to promote the development of reflective capacity.¹⁹⁵

A study by Boenink et al. in 2004 used case-vignettes to measure students' ability to reflect on challenging situations that trainees might encounter in medical practice. A semi-structured observer-rated instrument was developed to evaluate student responses. The authors define what they consider excellent reflection in medical practice as 'showing a balanced approach, considering all relevant perspectives, weighing up different interests, showing a keen eye for dilemmas and uncertainties, paying attention to the patient's viewpoint and demonstrating an evaluation of one's own position and latitude'. The study showed that the instrument used to measure reflection had acceptable psychometric properties, but further research is needed to validate its use in different settings and across different learner groups.¹⁹¹

Kember et al. developed the Questionnaire for Reflective Thinking (QRT) to measure students' reflective thinking.¹⁹⁴ Based on an extensive review of the literature, the authors identified four constructs that cover a broad spectrum of reflective thinking: (i) habitual action; (ii) understanding; (iii) reflection; (iv) critical

reflection. These are represented by four scales, each containing four items. These items feature as 16 statements about actions and modes of thinking during a course of study. The QRT was completed by 303 students from eight courses in the health science faculty of a university in Hong Kong. The questionnaire had acceptable Cronbach values and confirmatory factor analysis showed a good fit for the four-factor structure.

Pee et al. evaluated the ability of 26 dental therapy students to reflect on clinical experiences using a structured activity called 'A Learning Experience' (ALE).¹⁹⁶ Prompts for the ALE were based on the work of Boud and colleagues.¹⁹⁷ Three methods for assessing evidence of students' reflection in written worksheets were used: Johns' 18 questions¹⁸⁵, Hatton and Smith's criteria¹⁹⁸ and peer judgement. There was a low response rate, with just 53% of students submitting worksheets. The authors concluded that both Johns' questions and Hatton and Smith's criteria could serve as satisfactory research tools for assessing reflection in students' writing. However, the authors were unable to demonstrate that the use of ALE facilitated student reflection.

The work of Boud and Mezirow¹⁹⁹ provided the theoretical foundation for assessing the level of reflection from 45 reflective journals by Wong et al. in 1995.²⁰⁰ The authors developed a coding system to evaluate reflective journals. They concluded that student writing in reflective journals could provide evidence for the presence or absence of reflective thinking. Although they found that allocating students to one of three categories; non-reflector, reflector or critical reflector was practical and reliable, further attempts to allocate them into finer levels of reflection were considerably more problematic and unreliable.

Leung and Kember explored the relationship between students' approaches to learning and stage of reflective thinking, using a revised version of the Study Process Questionnaire and the Reflection Questionnaire.²⁰¹ The authors found that 3 of the factors in the Reflection Questionnaire, understanding, reflection and critical reflection correlated with a deep approach to learning. They concluded that the findings provide evidence of close association between approaches to learning and stages of reflective practice.

Sobral et al. developed a 10 item self-report questionnaire to assess students' self-reflection in learning. Students were asked to complete the questionnaire, along with an 11-item questionnaire of perceived competence for self-regulated learning and the 26-item Course Valuing Inventory (CVI), at the beginning and end of a 15-week term. The self-reflection in learning questionnaire had an acceptable Cronbach alpha value of 0.81. Four items of the CVI had strong correlations with the reflection scores. The study found that students who reported more reflective activities derived greater benefit and enjoyment from learning.¹⁸⁷ Sobral et al. used the Reflection in Learning Scale (RLS), the Course Valuing Inventory (CVI) and a version of the Approaches to Studying Inventory (s-ASI) to determine whether there was any relationship between reflection, approach to study, perceived learning outcome and academic achievement. The authors found the RLS could be used to appraise variation in medical students' reflective profile in terms of learning processing and self-monitoring.¹⁸⁸ The construct validity and reliability of the Reflection in Learning Scale was further supported in a subsequent study.²⁰²

2.9.9 Videos and reflection

‘Although technical knowledge and skills can be acquired through training with little reflective process, it is impossible to refine attitudes, acquire virtues and incorporate values without reflection’ – Shapiro²⁰³

The use of digital multimedia and emerging technology have the potential to facilitate deeper reflection.¹⁸³ In 2001 and 2004, Rosenhauser et al. surveyed US schools regarding the use of arts-related activities in medical education.²⁰⁴ The authors found that, in 2001, almost half of all US medical schools included the arts in the curriculum and two-thirds support extracurricular programs or activities. By 2004, the number was slightly higher with just over half of the schools offering required or elective arts-related courses. However, few schools were formally evaluating these courses and there was little information regarding their effectiveness in fostering well-being, observational skills or enhanced humanism.²⁰⁵

Brett-Maclean et al. found that short clips from movies were highly effective for introducing narrative reflective practice.²⁰⁶ Sanders et al. define digital storytelling

as ‘creating a story by the use of multimedia with the aim of stimulating reflection’ and conclude that ‘digital storytelling has potential to motivate students to engage in reflective learning’. The authors recommended further research and development to develop this new genre and they developed the following 12 simple ‘tips’ to assist educators using digital storytelling to promote reflection:²⁰⁷ (Table 2.9.9)

Table 2.9.9 Sander's 12 'Tips' for using digital storytelling to promote reflection

Number	Tip
1	Decide on the topic for the story
2	Write the story
3	Collect a variety of multimedia to create the story
4	Carefully select the multimedia to create the story
5	Create the story using a range of multimedia
6	Present the digital story
7	Encourage reflection at all stages of the project
8	Avoid being too ambitious
9	Provide adequate technical support
10	Develop a relevant assessment framework
11	Embed within existing teaching and learning approaches
12	Persuade the rest of your colleagues of its value

2.9.10 Conclusion

Reflection is essential for professional competence. Although we have seen growth in the development of instruments to assess students’ reflective abilities, the process of engaging students in meaningful deep reflection remains challenging. Gaining an understanding of the student characteristics that influence motivation to engage in reflective practice may enable educators to design more effective interventions. Many authors advocate the use of guided reflection or prompts to encourage students' engagement.¹⁸⁶ However, few studies have addressed the potential positive impact that guided reflection or other interventions can have in developing students’ reflective capabilities. Students often have limited authentic, practical experience upon which to reflect. Using digital multimedia and embracing emerging technology have the potential to facilitate deeper reflection and provide a means to foster the development of critical reflective skills in a structured learning environment.¹⁸³

2.10 Summary

Increasing student numbers, shorter hospital stays, super-specialisation and increased service demands have made the traditional teaching model increasingly unsustainable. We therefore need to consider alternative means to support both undergraduate education and postgraduate training. However, it is important to ensure that any changes to the traditional curriculum are evidence based and grounded in educational theory. In parallel with this, we need to recognise that teaching and learning in medicine is about more than merely assimilating knowledge; it is about becoming members of a community of practice.

Studies have shown that logbook can provide useful information about deficiencies in the curriculum and can focus attention on aspects of clinical teaching that need to be supported. The recognition and management of child abuse is an important example of a component of training that is critical for all doctors to gain exposure to and where there is a recognised need for more evidence based training to support learning at both undergraduate and postgraduate level.

Virtual Patients represent a heterogeneous group of new learning tools that are being developed to support the traditional teaching model. Although various patterns, categories and features to guide their development are emerging from the literature, it is still not clear what design features promote the most effective learning. Focusing attention on the type of instructional method used can help facilitate more effective learning within a Virtual Patient module.

However, in order for students to become members of the profession, they also need to be provided with opportunities to develop their professional identity and reflective capabilities. Reflection is recognised as an essential for professional competence. Videos can provide a means of integrating the teaching of clinical knowledge, professionalism and reflection into a single Virtual Patient module. Using digital multimedia in the form of Virtual Patients may have the potential to facilitate deeper reflection and provide a means to foster the development of critical reflective skills in a structured learning environment.

Chapter 3

Hypothesis, objectives, aims, research questions & methodology

3.1 Introduction

This chapter first describes the overall hypothesis, aim, research objectives and research questions. The ethical considerations of the study are then discussed, followed by a description of the study setting and population. The rationale behind the philosophical worldview taken in the study is then considered. The mixed method study design approach that is used in the study is then illustrated by the use of a table to guide the reader.

For research question 1, the rationale, study design, recruitment of participants and analysis of the data are described in detail. This is followed by a detailed description of the Virtual Patient module that was developed by the author to test the research hypothesis. This development of the module is presented in the form of 12 steps, which have been described in the literature to guide educators in the development of Virtual Patient modules. The methodology used to answer research question 2 is then presented. Each of the sub-questions is described individually and in logical order, including a discussion of the rationale for all chosen research methods.

3.2 Overall hypothesis

The hypothesis of this thesis is that the use of Virtual Patients does not significantly improve the development of clinical knowledge, professional identity and reflective skills in undergraduate medical students.

3.3 Aim

The aim of the research is to develop and evaluate the effectiveness of an online Virtual Patient module for developing clinical knowledge, professional identity and reflective skills in undergraduate students and postgraduate trainees.

3.4 Objectives

1. To assess to adequacy of the current paediatric curriculum

2. To design and develop an online interactive video-based Virtual Patient module to support students' learning
3. To evaluate the effectiveness of the module and determine the means by which its impact can be optimised

3.5 Research questions

3.5.1 Research question 1: Assessment of adequacy of current paediatric curriculum

Based on an evaluation of current undergraduate training, is there a need to supplement the traditional undergraduate paediatric curriculum to ensure students receive equivalent educational experiences to one another?

3.5.2 Research question 2: Effectiveness of Virtual Patient

Are Virtual Patients an effective learning tool to support undergraduate education?

Research sub-questions

- 2.1 Acceptability:** Do undergraduate students and postgraduate trainees view an online Virtual Patient module as an acceptable learning tool?
- 2.2 Clinical knowledge gain:** Does an online Virtual Patient module improve students' short-term and long-term clinical knowledge and how is this influenced by the instructional methods used?
- 2.3 Professional development:** Do Virtual Patients have a role to play in the development of students' professional identities?
- 2.4 Reflective practice:** Do Virtual Patients promote reflective practice?

3.6 Ethics approval and data storage

Ethics approval for the undergraduate studies was obtained from the Royal College of Surgeons in Ireland. Approval for the postgraduate study was obtained from the Royal College of Physicians of Ireland. Important ethical issues that were considered in this research study included:

- Informed consent
- Confidentiality
- Anonymity

In order to ensure that informed consent was obtained, all participants were provided with written information about the study, explaining what participation involved and addressing any potential risks. Importantly, all students and trainees were informed that the Virtual Patient module did not form part of their assessment in paediatrics. Prior to participating in the module, students and trainees had to read and agree to an online consent form which outlined the:

- Purpose of the study
- Procedures to be followed
- Voluntary participation
- Discomfort and risks
- Benefits to participant
- Benefits to education
- Statement of confidentiality

In addition, students and trainees participating in the focus group had to read and agree to a written consent form which outlined the:

- Purpose of the study
- Procedures to be followed
- Voluntary participation
- Discomfort and risks
- Benefits to participants
- Benefits to education
- Alternative procedures which could be utilised

- Time duration of the procedure and study
- Statement of confidentiality

The consent form explained how the audio recordings from the focus group would be transcribed, with all identifying information removed, and the tapes subsequently destroyed. Participants were informed that participation was voluntary and that they could leave the focus group session at any time and choose not to answer any or all questions. To allow students who may not have been comfortable speaking during the session to participate, an alternative means of providing feedback was given. All participants were given a 'Focus Group Follow-Up Sheet' which they could complete in private and return to the researcher. No identifying information was available on this sheet. All participants were asked to respect each others anonymity. The facilitator reminded the participants that the discussions were confidential and that the specifics of the discussion or individuals involved should not be disclosed outside the session.

In order to ensure that participants' identities were protected, anonymised data from the Virtual Patient module was stored on a password protected data-base which was accessible to the primary researcher alone. All participants were provided with their own unique username and password to ensure their anonymity. This was extremely important, as within the module students and trainees are asked to reflect on the video scenes and document their honest responses to questions. If students or trainees were concerned that they could potentially be identified by their responses, then the validity of their answers could be called into question.

3.7 Study setting

All studies of undergraduate students were conducted at the Royal College of Surgeons in Ireland (RCSI) during the academic year 2010-2011. Studies of postgraduate trainees were conducted at the Royal College of Physicians of Ireland during the academic year 2010-2011.

3.7.1 Undergraduate paediatric course

Paediatric Undergraduate students complete a 6-week paediatric rotation. During the rotation, weeks 1 and 6 are spent attending lectures, tutorials and problem-based learning sessions. Students attend a problem-based learning tutorial on child abuse and can review a campasia (audio and power point slide) presentation on the RCSI Virtual Learning site (Moodle). Students spend 2 clinical weeks in a tertiary paediatric referral hospital and 2 clinical weeks in a paediatric unit in a district general hospital. RCSI's affiliated clinical sites include 2 tertiary referral hospitals (The Children's University Hospital, Temple Street and Our Lady's Hospital for Sick Children, Crumlin) and 4 paediatric units in district general hospitals (Our Lady of Lourdes Hospital Drogheda, Mullingar Regional Hospital, Cavan General Hospital and Wexford General Hospital).

3.7.2 Undergraduate assessment in paediatrics

At the end of their paediatric rotation, students complete an End of Course (EOC) examination that accounts for 60% of their final mark in paediatrics. The EOC examination consists of 50 Best of 5 MCQs, a written paper, an Evidence Based Medicine assignment, completion of a logbook and a clinical communication OSCE examination. At the end of the academic year, students complete an End of Year (EOY) examination, accounting for the remaining 40% of marks. The exam consists of a problem-based learning written paper (8 questions) and clinical OSCE assessment. Four groups of students completed a six-week paediatric rotation during the period of study. Group 1 completed their rotation early in the year, with group 4 completing their rotation just before the final End of Year examination.

3.7.3 Study population and recruitment

All undergraduate medical students completing their paediatric rotation were invited to participate in the Virtual Patient module evaluation (n=224). All students were informed of the research project during week one of their paediatric module. Completion of the module did not contribute towards their summative or formative

assessment. All students were sent their own unique username and password with a link to the Virtual Patient site.

Participating students were asked to:

- Complete an online evaluation questionnaire
- Participate in a focus group discussion
- Complete a pre and post module MCQ examination
- Document their responses to professional dilemma scenarios
- Document their reflections in response to five video scenes in the Virtual Patient module

All Basic Specialist Trainees participating in the Basic Specialist Study day in the Royal College of Physicians in 2010 were invited to participate in the study. Participation in the Virtual Patient case discussion did not contribute towards their formative or summative assessment. All Basic Specialist Trainees were also invited to participate in the online module.

3.8 Philosophical worldview proposed in study

In research, there are four recognised philosophical worldviews or paradigms that guide decision-making: postpositivism, constructivism, advocacy/participatory and pragmatism. Different paradigms have their own preferred methods and theories. Pragmatism sits in the middle of a philosophical continuum ranging from positivism to constructivism.

Pragmatism is a set of ideals that emphasises the research problem using diverse approaches and values and both objective and subjective knowledge to understand the problem.²⁰⁸ It is concerned with action and with the practical application of meaning i.e. does an intervention work under real life conditions? Creswell states that for the mixed methods researcher, pragmatism opens the door to multiple methods, different worldviews and different assumptions, as well as different forms of data collection and analysis²⁰⁹.

In this thesis, the pragmatic worldview was chosen as it represents a practical and applied research philosophy. This research builds upon the previous knowledge and experience the author had gained in Virtual Patient development and evaluation. In order to disprove the overall hypothesis, this research addressed a variety of research questions exploring the various aspects of the Virtual Patient module including students' and trainees' acceptability of the module, and its impact on learning, professional development and reflective practice.

The pragmatic viewpoint allowed the author to investigate what she considers important and to use both qualitative and quantitative methodologies. In recent years, there has been a significant growth in the development of Virtual Patients, which have begun to enter the mainstream of medical education. However, the evidence base to guide their use is only beginning to be accumulated. The author therefore wanted to collect and analyse data that would provide practical and useful information to inform real world practice and provide practical solutions to guide the future use of Virtual Patients.

3.9 Study design

This study adopted a mixed method research approach, which suits the pragmatic research viewpoint. A mixed method research design refers to the use of two or more methods in a research project yielding both qualitative and quantitative data.²¹⁰

There are several classification systems for mixed method research designs in the literature. The most commonly used classification systems focus on whether qualitative and quantitative research is conducted sequentially or concurrently. In selecting the approach for the research project, the author chose a multilevel mixed method study design, which incorporates multiple levels of input. In this design, qualitative data are collected at one level, and quantitative data collected at another level, in a concurrent or sequential manner in order to answer interrelated research questions with multiple approaches. This approach allowed the author to address the various educational aspects of the Virtual Patient module, by using both qualitative and quantitative methods at different stages in the study, enabling the triangulation of

the data, while recognising that every method has its limitations and that different approaches can be complimentary. (Table 3.9)

Table 3.9 Study research design

Research Question	Research theme	Research question number	Quantitative methods	Qualitative methods
Based on an evaluation of current undergraduate training, is there a need to supplement the traditional undergraduate paediatric curriculum to ensure students receive equivalent educational experiences to one another?	Current paediatric curriculum	1	Review of student log books	
Do undergraduate students and postgraduate trainees view an online Virtual Patient module as an acceptable learning tool?	Acceptability	2.1	Student and trainee evaluation questionnaire	Student focus group
Does an online Virtual Patient module improve students' short-term and long-term clinical knowledge and how is this influenced by the instructional methods used?	Clinical Knowledge gain	2.2	Online pre and post module MCQ Problem-based learning child abuse question	
Do Virtual Patients have a role to play in the development of students' professional identities?	Professional identity	2.3	Response to professional dilemma scenario	
Do Virtual Patients promote reflective practice?	Reflective practice	2.4		Scoring instrument

3.10 Statistical analysis of quantitative data

Quantitative data were analysed using SPSS version 18. Data were entered into SPSS and descriptive analysis was used to check for outliers. For all analyses, statistical

significance was taken as $p < 0.05$. Parametric and distribution free methods were used throughout the analyses. Where no major discrepancies between the two approaches were found, the results of parametric tests are reported.

3.11 Research question 1: Assessment of adequacy of current paediatric curriculum

Based on an evaluation of current undergraduate training, is there a need to supplement the traditional undergraduate paediatric curriculum to ensure students receive equivalent educational experiences to one another?

3.11.1 Rationale

All students should receive equivalent educational experiences to one another. In order to determine whether there is a need to supplement the traditional undergraduate paediatric curriculum with additional learning resources, such as Virtual Patients, a review of student logbooks was undertaken. This enabled the author to determine the type and range of cases students encounter during their undergraduate training and identify important cases that students are not gaining exposure to.

3.11.2 Study design and recruitment

Paediatric students completing their clinical rotation during the academic year 2010/2011 were asked to document case histories that they had taken. All students were given a pocket- sized logbook to document supervised cases that they had been actively involved in either history taking and/or clinical examination. Students were encouraged to document 20 histories covering a variety of cases. These supervised cases had to be presented to a member of the medical team and signed off accordingly. The logbooks were returned to the Department on day 3 of week 6 of their rotation. The logbooks contributed towards the student's summative assessment.

3.11.3 Analysis

The logbooks of the entire student cohort ($n=224$) were reviewed and the data entered into SPSS. Data were categorized according to sub-speciality and primary diagnosis. Where the diagnosis was unclear, the main presenting symptom or sign

was documented. The number of times a student was exposed to the same diagnosis or presenting complaint was recorded. The *number* of cases seen refers to the total number of diagnoses or presenting symptoms or signs documented by each student regardless of repetition. The *variety* of cases seen refers to the number of unique diagnoses or presenting signs or symptoms seen by each student and does not include cases that were seen more than once. Students were grouped according to the number of cases seen, the variety of cases seen and examination scores (binarised on the mean).

3.11.4 Academic ranking of cases

Academic staff from the Department of Paediatrics were asked to rate the diagnoses or symptoms on a scale of 1 to 3, with 3 being essential, 2 desirable and 1 optional. Correlation between the importance rating of a disease or symptom and students' exposure to the same was determined. Correlation between the variety of case exposure and students' examination performance was also determined.

3.12 Study Objective 2: Design and develop an online interactive video-based Virtual Patient module to support students' learning

3.12.1 Introduction

In order to encourage and provide pragmatic, evidence-based guidelines for educators interested in developing Virtual Patients, Posel et al. developed a guide for the development of Virtual Patients entitled '12 Tips: Guidelines for authoring Virtual Patient cases'²¹¹ (Table 3.12.1)

Table 3.12.1 12 Tips: Guidelines for authoring Virtual Patient cases

Number	Tip
1	Determine case content and choose a design model
2	Organize your storyboard and case before you start
3	Manage case complexity and match it to the case objectives
4	Include assessment and feedback from the start
5	Support an individualised approach to learning
6	Use your Virtual Patient to encourage collaboration and collaborative learning
7	Tackle interactivity
8	Anticipate and navigate
9	Ensure privacy and confidentiality of data
10	Integrate evaluation
11	Recognise the potential of expert traces and the use of script concordance
12	Choose the right authoring application for your case

The following section is a reflective account, written in the first person, of the process involved in following these 12 steps to develop an online interactive video-based Virtual Patient module to support undergraduate learning about the recognition and management of suspected child abuse.

3.12.2 Step 1 Determine case content and choose a design model

Posel et al. recommend that the content of a case should:

1. Be a relevant story that will capture a learner's interest
2. Be based on a pedagogical framework
3. Use a conceptual design that is suitable for the narrative and the learner

Students at the Royal College of Surgeons in Ireland spend 6 weeks completing their paediatric rotation. During this time they are expected to gain experience and knowledge of the core curriculum as outlined in their course handbook. The core curriculum covers a broad range of specialities to which students are expected to gain exposure. (Table 3.12.2)

Table 3.12.2 Paediatric core curriculum speciality requirements

Paediatric Core Curriculum	
Emergency Medicine	Community Child Health
Ophthalmology	Gastroenterology
Dermatology	Respiratory and ENT
Cardiology	Genetics
Metabolic Conditions	Immunology
Neonatology	Paediatric Surgery
ENT	Infectious Disease
Health and Nutrition	Nephrology
Haematology and Oncology	Child Psychiatry

Following a review of the core curriculum and based on my own experiences as both a student and trainee, I identified important cases that students would be unlikely to encounter during their six-week rotation. Included in this list were bacterial meningitis and meningococcaemia, non-accidental injury and child sexual abuse. After reviewing the literature, I decided to focus on non-accidental injury, as this is a particularly neglected area of undergraduate education and many doctors are dissatisfied with their training in non-accidental injury.²¹² A review of the clinical logbook for the students in the academic year 2010-2011 confirmed that students get little if any exposure to child abuse, which is considered by our academic department to be an essential case. As child abuse is one of the most difficult subjects to teach in paediatrics, I felt the case would challenge students and ensure engagement in the module.

I based the case on a pedagogical framework by aligning the learning outcomes to both the paediatric and personal and professional development curriculum. (Figure 3.12.2)

Figure 3.12.2 Learning outcomes of Virtual Patient module

<p>Skills</p> <ul style="list-style-type: none">• Identify points in a history or physical exam which may lead to the suspicion of child abuse• Demonstrate appropriate methods of communication to inform families about any concerns you may have• Illustrate how to write proper notes in a patient's chart <p>Knowledge</p> <ul style="list-style-type: none">• Understand the role of the doctor as an advocate for children's rights• Recognize when to refer to senior colleagues• Demonstrate awareness of the importance of good record keeping as an integral part of good medical practice, especially in cases of suspected child abuse <p>Attitude</p> <ul style="list-style-type: none">• Demonstrate awareness that doctors can help in preventing child abuse and neglect by knowing how to recognise signs of abuse and report them to the proper channels• Recognise limitations of your own experience and take advice from others as appropriate
--

These learning outcomes were further validated by mapping them against the principles of Duties of a Doctor set out below (GMC 2000).²¹³

- Make the care of your patient your first concern
- Treat every patient politely and considerately
- Respect patient's dignity and privacy
- Listen to patients and respect their views
- Give patients information in a way they can understand
- Respect the right of patients to be fully involved in decisions about their care
- Keep your professional knowledge and skills up to date
- Recognize the limits of your professional competence
- Be honest and trustworthy
- Respect and protect confidential information
- Make sure that your personal beliefs do not prejudice your patient's care

- Act quickly to protect patients from risk if you have good reason to believe that you or a colleague may not be fit to practice
- Avoid abusing your position as a doctor
- Work with colleagues in the ways that best serve the patient's interests

In 2007, Peterson and Powell described three different models that can be used when developing Virtual Patients: linear, branching or exploratory.²¹⁴ From previous published qualitative research that I had conducted using focus groups to explore students' perceived effectiveness of a pilot Virtual Patient module, I had identified several design factors that could maximize the educational benefit of Virtual Patients.²¹⁵ Among these, was the opportunity to influence how a case progressed. In the design of the Virtual Patient module, I therefore decided to utilize a branched model.

3.12.3 Step 2 Organise and storyboard your case before you start

Posel et al. recommend that developers should next determine the developmental processes that will be used and the resources that are available.

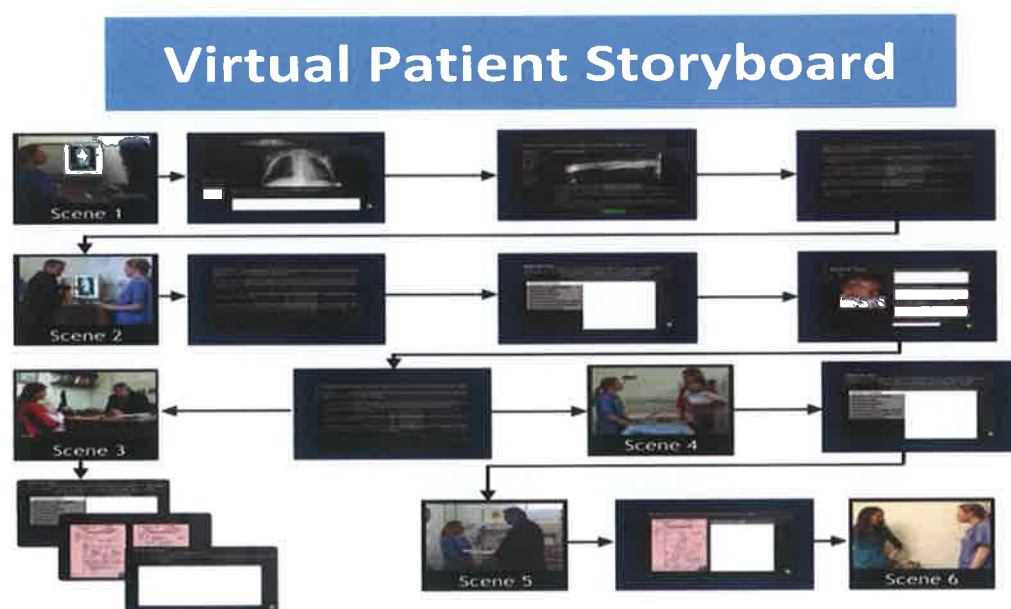
Over a period of 3 months, the second Virtual Patient was developed. A development team was established with representation from the departments of paediatrics, medical education and e-learning. During this time, I drafted the Virtual Patient script that was then reviewed by academic staff within the Department of Paediatrics. One of the problems I identified with the pilot Virtual Patient was that using hospital or academic staff to play the role of patients or healthcare professionals reduced the potential authenticity of the case. I arranged for actors to play the lead roles. Unfortunately, due to funding restrictions I was unable to secure professional actors for all the roles in the Virtual Patient module.⁵⁶ Therefore, in an effort to minimize cost expenditure, I played one of the healthcare professional roles.

In order to ensure authenticity, I obtained approval to film the videos in the Emergency Department of the Children's University Hospital, Temple Street. Considerable time was spent determining relevant tasks to promote interactivity and engagement in the module. Multimedia images, which were to be incorporated into

the module, were collected and consent obtained from the relevant authorities. Supporting documentation and references were collated and drafts of the Virtual Patient module were scripted.

A storyboard was created outlining the sequence of video clips and the supporting learning material and interactive questions and tasks which would connect the individual video clips to make the Virtual Patient module. (Figure 3.12.3)

Figure 3.12.3 Image of Virtual Patient Storyboard



3.12.4 Step 3 Manage case complexity and match it to the case objectives

Posel et al. state that case complexity should be determined by four factors;

1. The level of the target learner
2. The content or story
3. The knowledge domain or domains required for case resolution
4. The cognitive load

The target learners of the Virtual Patient module were undergraduate paediatric students. Undergraduate students completing their paediatric course have had previous medical, surgical and speciality clinical attachments and therefore have had

'hands on experience' on the wards and in clinics. However, for the majority, this would be their first paediatric experience. During a short six-week rotation, they gain clinical paediatric experience by reviewing patients in the Emergency Department, on the wards and in the outpatients. They have dedicated tutorials, lectures, bedside teaching and problem-based learning sessions, and are supervised taking histories, performing examinations and presenting their findings and management plans.

Undergraduate medical students have limited exposure to child protection cases over the course of their training. Therefore, I felt a child protection scenario would represent a complex case for undergraduate students to learn from. I wished to address more than cognitive skills and to help students explore and reflect upon the professional difficulties involved in the diagnosis and management of suspected abuse.

3.12.4.1 Outline of Virtual Patient case

A seven-month old child is brought to the Accident and Emergency department by her mother with a three day history of a cough, temperature and decreased feeding. Although the Senior House Officer thinks that the infant most likely has a viral infection, she orders a chest X-ray so that she can reassure the mother that no antibiotics are needed. Amy, the Senior House Officer, fails to notice that the infant also has some bruises on her cheeks. The triage nurse brings this to her attention. However, Amy dismisses the bruises as an incidental finding of no clinical significance. (Figure 3.12.4.1a)

Figure 3.12.4.1a Image of Amy and nurse



When Amy is viewing the CXR on the viewing box, her colleague notices an abnormality on the film. Again, Amy dismisses her colleague and assures her that although she may have limited experience in paediatrics, she is capable of reading a CXR. Amy, however, is a little concerned by what she may have failed to diagnose in the CXR.

In order to help students gain a better understanding of professionalism, the students are asked to decide, from one of four options, what they think Amy should do next? (Figure 3.12.4.1b)

Figure 3.12.4.1b Image of Professional Dilemma scenario 1

Question 1 | Question 2

Amy does not know what the abnormality in the CXR is. What should she do now?

1. Go back to her colleague, apologise for storming off and ask her what she has missed in the CXR
2. Send the patient home with the diagnosis of a viral infection and give the CXR in for reporting, that way any abnormality will be picked up and she can follow it up tomorrow if something has to be done
3. Take the CXR to the radiologist to ask for their opinion. If there is any abnormality she can inform the A&E consultant
4. If her colleague says there is something wrong then she should inform the A&E consultant

For each answer feedback is given. For example, if students select answer 1, which is incorrect, they will be given an explanation (example below) as to why, and then allowed another attempt at the question.

- *Although Amy will need to apologise to her colleague for acting unprofessionally and storming off, her first priority is the health and safety of the baby. She therefore needs to consult with a more senior colleague about the CXR findings.*

In this case the best answer is number 3.

- *Taking the CXR to the radiologist to ask for their opinion is the correct answer. Although Amy will need to apologise to her colleague for acting unprofessionally and storming off, her first priority is the health and safety of the baby. She therefore needs to consult with a more senior colleague about the CXR findings.*

Sending the patient home knowing that there is an abnormality on the CXR would be unprofessional. Although the CXR will be given in for reporting by the consultant radiologist, the baby may be in danger of further abuse and, therefore, prompt action needs to be taken.

Senior assistance in this case is needed. However, Amy does not know what the abnormality on the CXR is or its' significance and she appears to have totally disregarded the bruises.

Therefore, in order to determine whether she needs assistance from a senior registrar first or whether the consultant needs to be informed, she needs to determine what abnormality is present.

So the issue is not whether Amy missed the diagnosis, the important point is that Amy is seeking help and has recognised, to some degree, the limitations of her own experience.

Amy then takes the CXR to the radiologist to ask for his opinion. The students watch the video interaction of the radiologist and Amy. The consultant expresses his concern that Amy has failed to attend several teaching sessions and at this stage in her training 'should be able to interpret a CXR'. He then confirms that there are

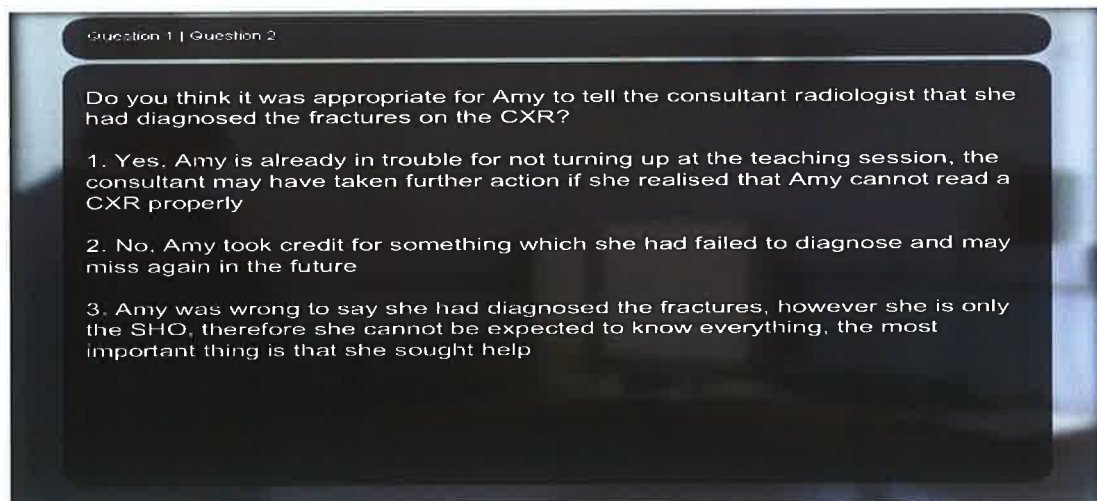
several old rib fractures with callous formation present on the CXR and actually commends Amy for diagnosing the fractures. (Figure 3.12.4.1c)

Figure 3.12.4.1c Image of Amy and the consultant radiologist



The students are then asked whether they think it was appropriate for Amy to tell the consultant radiologist that she had diagnosed the fractures on the CXR. (Figure 3.12.4.1d)

Figure 3.12.4.1d Image of Professional Dilemma scenario 2



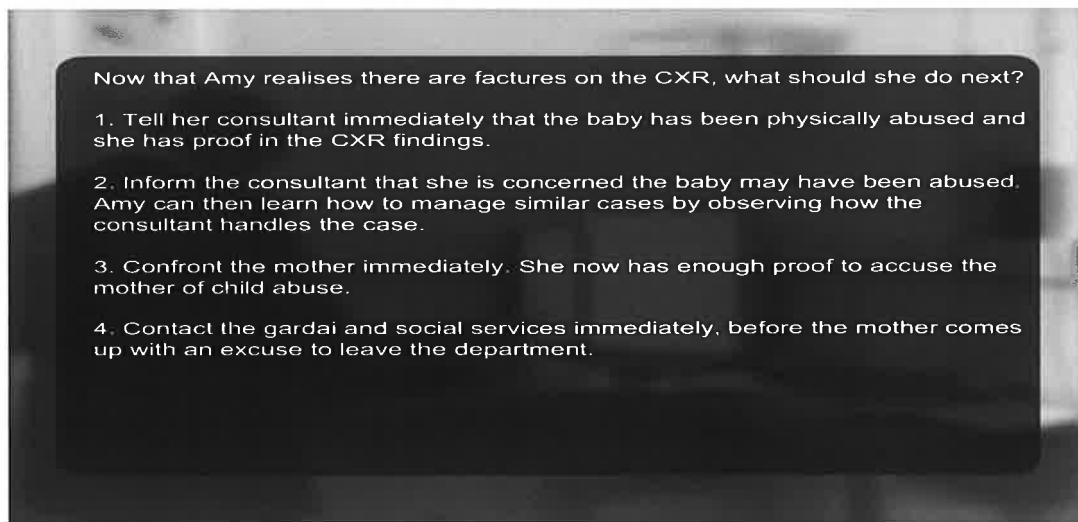
Again the students are given feedback on their answers. In this case the ideal answer is number 3.

Amy was right to go to the consultant to ask her for help interpreting the CXR. The issue however is not whether Amy can read a CXR properly. She is still in training

and therefore is not expected to know everything. She is however, expected to be aware of her limitations and know when to ask for help.

Further progression of the case depends on students' response to the question: 'Now that Amy realises there are fractures on the CXR, what should she do next?' (Figure 3.12.4.1e)

Figure 3.12.4.1e Image of Professional Dilemma scenario 3



If the students think Amy should confront the mother regarding the fractures, the scene depicts Amy approaching the mother and accusing her of child abuse. Amy, who has never managed a case of suspected child abuse before, handles the situation carelessly. The mother storms out of the Emergency Department and Amy is left to deal with the consequences. Her consultant, who sees the angry mother leave the department, reprimands her for not bringing the case to his attention sooner. (Figure 3.12.4.1f)

Figure 3.12.4.1f Image of Amy and the mother



If students select option 4, Amy raises her concerns immediately with the consultant. The scene then depicts the conversation between the consultant and the mother. The consultant takes a detailed medical and social history from the mother. During the course of the interview it transpires that there have been difficulties at home. Due to financial difficulties, the mother has had to cut her maternity leave short and return to work. Her partner, who has little experience in caring for children, is now looking after the baby while she is at work. The tearful mother acknowledges that the home environment is extremely stressful and her husband is finding it difficult to cope. The consultant gathers information about the family's medical history and explains to the mother that the injuries are a cause for concern that could not be explained by a simple fall from a baby bouncer. He explains that admission to hospital and further investigations are needed. (Figure 3.12.4.1g)

Figure 3.12.4.1g Image of the mother and the consultant paediatrician



3.12.5 Step 4 Include assessment and feedback from the start

As assessment drives learning, it is an important component of any educational module. According to Posel et al., assessment can help determine:

- The learner's prior knowledge and skills
- The learner's level of prerequisite knowledge
- The degree of individual or group knowledge transfer through outcome measurement
- Errors in fact, decisions and rationales made by learners

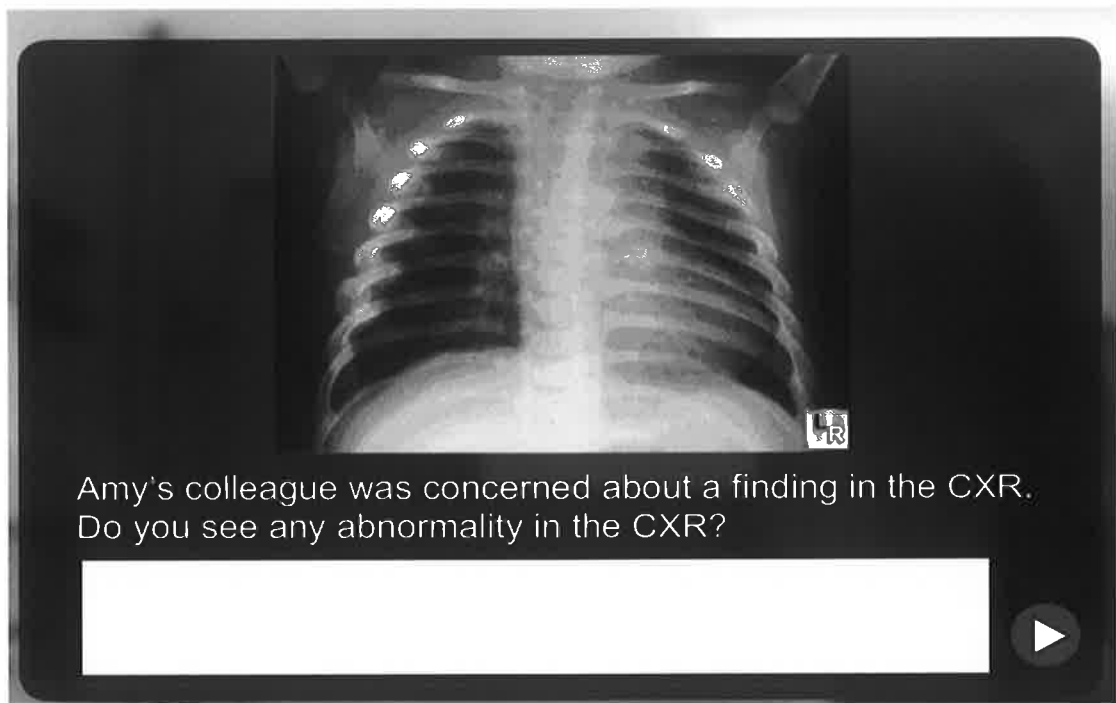
In this study, the Virtual Patient module did not contribute to students' formative or summative assessment. However, throughout the module there were opportunities for self-assessment. In addition, I developed a pre- and post-module MCQ to enable learners to assess their prior knowledge and to determine whether completion of the module advanced their understanding of the recognition and management of suspected child abuse. Feedback is an important motivator for students and an

essential component of learning. Therefore, throughout the module, focussed feedback was automatically given to students in response to their answers.

3.12.5.1 Example of questions and associated feedback

When Amy's colleague raises concern about a finding in the CXR, the students are asked to identify the abnormality. (Figure 3.12.5.1a)

Figure 3.12.5.1a Image of chest x-ray



Feedback is then automatically given when the students type in their answers. The text box which appears when the student submits his/her answer, explains that

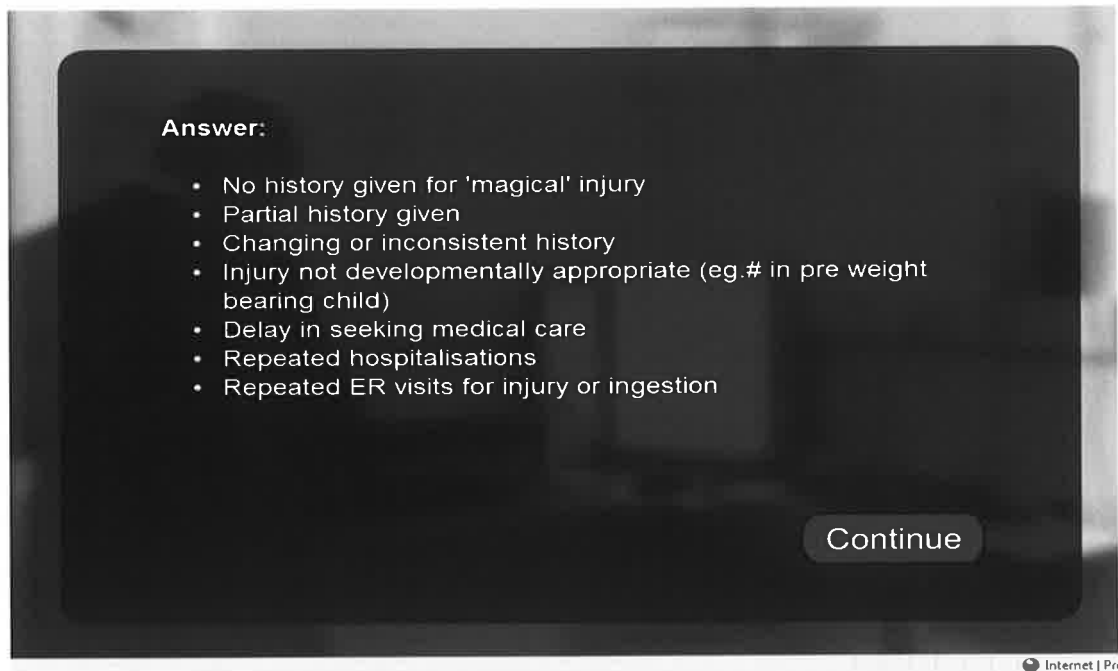
- *The CXR shows multiple rib fractures with callous formation, including a fracture of the left 2nd and 6th rib posteriorly*

A second Question box then asks the students: What if any is the significance of these injuries? Again, feedback is automatically given when the students type in their answers

- *Posterior rib fractures in the absence of a history suggestive of severe trauma (e.g. Motor Vehicle accident) are strongly suggestive of child abuse.*

A further Question box, midway through the Virtual Patient, asks the students what points in a history are suggestive of child abuse. After the students submit their response, they are provided with a text box that outlines a list of factors in the clinical history that may raise the suspicion of child abuse. (Figure 3.12.5.1b)

Figure 3.12.5.1b Image of answers to question box



3.12.6 Step 5 Support an individualised approach to learning

Each learner will approach cases from a different perspective, based on their own personal or professional experience. Cases of suspected child abuse can be particularly emotive for students and health care professionals alike. Therefore, I felt it was important to give students the opportunity to reflect on the scenarios depicted in the module in order to gain an understanding of their attitudes, values, preconceptions and assumptions. I therefore integrated several opportunities for reflection within the Virtual Patient module as follows:

- How do you think Amy handled the situation?
- How do you think the consultant handled the situation?
- What do you think were the positive aspects of his approach?

- Handling cases of suspected child abuse can be difficult for even experienced doctors. We would now like you to reflect on the case you have just completed.
- We would like you to consider under what circumstances do you think the baby should be allowed back into the care of her mother?

Individualisation can also be supported by giving learners control over the learning environment. I developed a branching Virtual Patient, where the story changes depending on the decisions made by learners. Students are given the opportunity to see the impact of their decisions on clinical outcomes in a safe, controlled, virtual environment. This decision-consequence relationship is considered an educationally valuable characteristic of Virtual Patients.⁵³

3.12.7 Step 6 Use your Virtual Patient case to encourage collaboration and collaborative learning

In 2008, Ellaway et al. highlighted the importance of sharing resources, knowledge and Virtual Patient development tools and software⁵⁴. Subsequent papers have called for stronger collaboration and sharing of content with the wider community²¹⁶. In order to encourage collaborative learning, the Virtual Patient module was used to facilitate a group discussion with paediatric Basic Specialist Trainees. In addition, it was made available for review by all five medical schools in Ireland.

3.12.8 Step 7 Tackle interactivity

According to Posel et al.²¹¹, 'Interactivity can heighten a learner's sense of participation and this, in turn, can facilitate the meaningful learning that is associated with 'active cognitive processing' as well as deliver reproducible, standardized educational experiences to learners in which they are active and dynamic participants'. Based on my previous research, I had learned that increasing interaction within a Virtual Patient module could improve its learning potential by making it more engaging and stimulating for students. Therefore, I used several different multimedia tools to encourage interactivity:

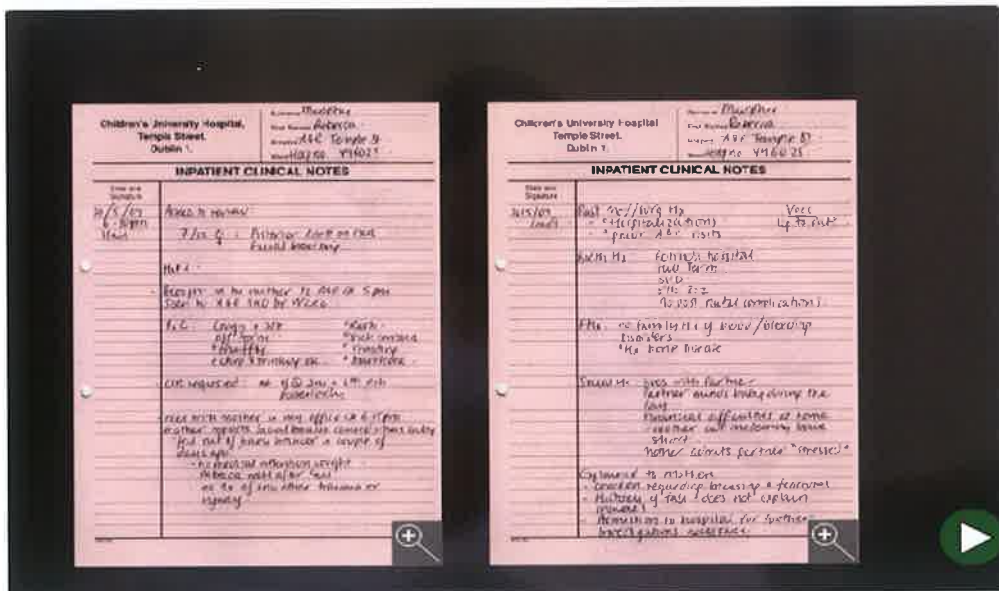
- Professional dilemma scenarios

- Reflection boxes
- Questions boxes
- Radiology images and questions
- Clinical notes
- Picture quizzes

3.12.8.1 Example of clinical notes

Students are asked to correctly identify problems with the documentation. (Figure 3.12.8.1)

Figure 3.12.8.1 Image of clinical notes

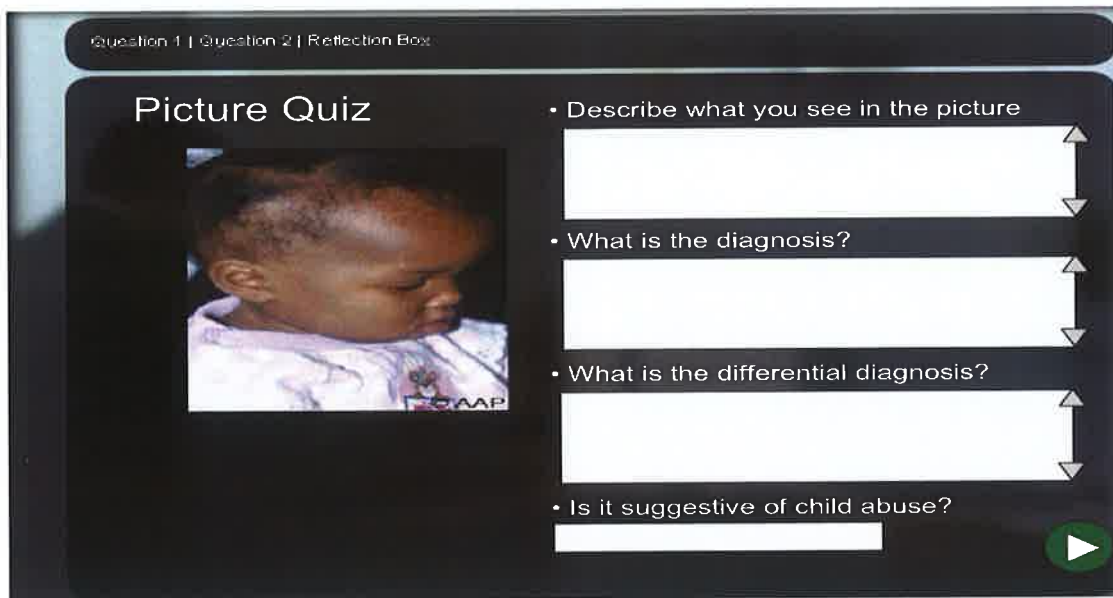


3.12.8.2 Example of picture quiz

Students are asked a series of questions in response to images of skin conditions. (Figure 3.12.8.2)

Figure 3.12.8.2

Image of picture quiz



3.12.9 Step 8 Anticipate and navigate

Cognitive load theory highlights the importance of not overwhelming learners with complex instructional material. The recognition and management of child abuse represents a complex case with an associated high intrinsic load. It was important in the design of the Virtual Patient module that intrinsic, extraneous and germane loads were well balanced. This was one of the most challenging aspects of the design of the Virtual Patient. As the module was built from scratch, and without the use of sophisticated software programs, it took several attempts and revisions to finally divide the module successfully into bite-sized chapters, which followed a similar format and used the same relatively intuitive navigational controls throughout.

3.12.10 Step 9 Ensure privacy and confidentiality of data

Maintaining the authenticity of cases is important to ensure that students fully engage with and relate to the module content. Virtual Patients can be developed based on actual clinical cases, combinations of different cases or imagined scenarios. Real life cases of suspected child abuse are often too complex for undergraduate students. However, incorporating elements of these into a tailor-made learning resource can help ensure authenticity is maintained, case complexity is appropriate and learning

objectives are met. In addition, this ensures that patient privacy and confidentiality are not breached.

In addition to patient confidentiality, learners' privacy and confidentiality have to be addressed. This was ensured by gaining ethical approval from the Royal College of Surgeons in Ireland. Prior to participating in the Virtual Patient module, students had to complete an online consent form.

Data from the Virtual Patient module were stored on a password-protected database accessible only to myself. Each individual student was given his/her own unique username and password along with a link to the site. All data were anonymised.

3.12.11 Step 10 Integrate evaluation

The use of Virtual Patients in undergraduate medical education is a relatively new concept and, although we are embracing their use, we have much to learn. Optimising the use of Virtual Patients in undergraduate medical education requires a commitment to rigorous evaluation and responsive developments which take into consideration students' views and learning needs. Several methods were thus used to evaluate the Virtual Patient module. At the end of the module all students were required to complete an evaluation questionnaire which provided opportunities to record additional comments through the use of free text boxes. In addition, I conducted focus groups to explore students' views and identify potential areas for improvement.

3.12.12 Step 11 Recognise the potential of expert traces and the use of script concordance

Although national guidelines exist to support professionals involved in the child protection process, individuals vary widely in their approach.. Therefore, in developing the story and associated script for the Virtual Patient, input from a variety of health professionals was sought. Expert opinions were particularly important in determining the ideal responses to the professional dilemma boxes and understanding the rationale behind preferred options.

3.12.13 Step 12 Choose the right authoring application for your case

With the increasing utilisation of Virtual Patients in undergraduate medical education, a growing number of authoring applications have been developed. Virtual Patients are costly to develop and, therefore, the use of templates is encouraged so that multiple learning modules can be shared, developed and maintained. The majority of existing modules are problem-solving Virtual Patients which focus on fostering skills of clinical reasoning and diagnosis. Within the module, students are required to gather information and use it to make diagnoses and manage and treat patients. In contrast, narrative Virtual Patients are concerned with cause and effect. Templates are difficult to create as each tells a unique story and, therefore, needs to be individually made. I, therefore, had to create my own application to fit the requirements of my narrative Virtual Patient.

3.13 Research question 2

3.13.1 Research sub-question 2.1: Acceptability

Do undergraduate students and postgraduate trainees view an online Virtual Patient module as an acceptable learning tool?

In order to determine whether students and trainees viewed the Virtual Patient as an effective learning tool and identify factors that are important in promoting learning within a Virtual Patient module, three separate evaluations using both qualitative and quantitative approaches were undertaken.

3.13.1.1 Evaluation 1: Focus group evaluation of undergraduate paediatric medical students

3.13.1.2 Rationale

Focus group discussion is a research methodology used when an exploration of different ideas and opinions is needed. This methodology was chosen as the author had experience in conducting focus groups and analysing qualitative data. In addition, as students had completed the Virtual Patient independently, the author wanted an opportunity to bring them together, allow them to interact with one another by questioning and challenging each other's opinions and thinking aloud

with their peers about their individual experiences of the Virtual Patient. The author felt that this would generate more in-depth insight and discussion than individual interviews alone. Two student focus groups were conducted to help provide insight into the factors that facilitate student learning within a virtual environment.

3.13.1.3 Participant recruitment

Students completing their paediatric rotation were invited to participate in the focus group discussion. A total of 20 students volunteered to participate in two focus groups that lasted for ninety minutes each. At the beginning of each focus group, informed written consent was obtained from participants.

3.13.1.4 Conduct of focus group

The author led each focus group, which lasted 90 minutes. Discussion was encouraged through the use of a standard script of open-ended questions. Although open debate and discussion were encouraged throughout the focus group discussions, the students were interrupted if they digressed to such an extent that they no longer focused on issues relevant to the study. Consensus was not a goal and dissent was invited. One of the potential problems with focus groups is that, during discussions, some participants may dominate the discussion. Therefore, in order to encourage contribution from all participants, everyone's opinions were solicited actively and the author repeatedly stressed the value of both positive and negative experiences.

Consistency across the groups, in the way questions were asked, was enhanced by using a 'questioning route', i.e. a sequence of questions in complete sentences that guides the interviews.

1. What is your overall impression of the Virtual Patient?
2. How educationally valuable is the Virtual Patient and why?
3. Why did the Virtual Patient improve your learning experience?

3.13.1.5 Data collection

Sessions were audio taped and transcribed. Participants were anonymized during transcription. In order to ensure the accuracy of the transcripts, they were cross-checked by comparing them directly to the audiotapes. Both transcripts were then analysed by the author and subsequently validated independently.

3.13.1.6 Development of coding frame

A thematic content analysis was used to capture these concepts and synthesize the range of opinions expressed²¹⁷. Both transcripts were read in full before the script was divided into sections and codes or labels were assigned to each section. Sections with similar meanings were grouped together and codes were assigned to the groupings. The codes linked together pieces of text, which represented a common viewpoint or perspective, related to one of the key questions or central purposes of the study. As the transcripts were analysed, a clearer pattern of similarities and differences between the codes emerged. This complex pattern of codes was restructured to include broad, over arching themes within which were subdivisions or categories. Consensus on themes was reached via discussion among investigators.

3.13.2 Evaluation 2: Development of questionnaire to assess the module

3.13.2.1 Rationale

The author was aware of only one validated tool to assess Virtual Patients²¹⁸. However, this tool is concerned with curricular integration and, therefore, was not appropriate for an evaluation of an individual module. The author, therefore, sought to develop and evaluate a questionnaire to assess students' opinions about the Virtual Patients' impact on learning and module content and structure. The author wished to develop a short instrument with simple questions focussed on eliciting the students' general impression that could be used immediately after completion of the module.

3.13.2.2

Questionnaire development

The content of the questionnaire was derived by collating items from previous existing questionnaires, focus group research on Virtual Patients previously published by the author,²¹⁵ a review of the available literature and educational theory.

3.13.2.2.1 Focus group research on Virtual Patients

Students in the focus group found Virtual Patients to be a useful and engaging addition to their undergraduate curriculum. Specifically, students valued cases that were interactive and authentic, that guided them in reflective practice, integrated the teaching of professionalism and increased clinical knowledge.

3.13.2.2.2 Literature review

A literature review was conducted to determine if there were any existing validated questionnaires assessing students' use of and learning from Virtual Patient modules, which could be used or modified for use in the evaluation. Only one paper describing the standardisation of an instrument for evaluating the curricular integration of Virtual Patients was identified.²¹⁸ However, as that Virtual Patient module focused on clinical reasoning skills, the questionnaire items were unsuitable for this intervention.

The literature review was then expanded to include non-validated tools that might be useful to inform the structure and content of the questionnaire. Questions from the CLIPP Questionnaire were adapted.⁵⁷ That online questionnaire was used to gain student feedback on 31 computer assisted instruction cases. The authors sought feedback on the individual case content and pedagogy. This structure was used to inform the questionnaire factor development.

The questions concerning case content that were adapted from the CLIPP questionnaire were:

- The case teaches the listed learning objectives
- The expert comments provided useful additional information

- The case was appropriate for my level of training

3.13.2.2.3 Educational theory

Adult learning theory provided the theoretical framework for creation of factor 1; impact on learning. Malcolm Knowles described 6 characteristics of adult learners:

- Adults are autonomous and self directed
- Adults have accumulated a foundation of experiences and knowledge
- Adults are goal orientated
- Adults are relevancy orientated
- Adults are practical
- Adults need to be shown respect

Adult learners are independent and need to understand how the learning will benefit them and how it will fit into their existing knowledge. The following table provides an example of the questionnaire items and the associated principle of adult learning theory that it addresses. (Table 3.13.2.2.3)

Table 3.13.2.2.3 Questionnaire items and associated principle of adult learning

Principle	Item
Adults are goal orientated	The learning goals for the module were clearly stated
Adults are practical	The module did not reflect real life situations
Adults are relevancy orientated	Child abuse is not an important issue for undergraduate training in paediatrics
Adults are autonomous and self directed	The module helped me identify deficits in my knowledge The module helped me to reflect on professional issues
Adults have accumulated a foundation of experiences and knowledge	Upon completion of the module, I am more aware of the difficulties surrounding the diagnosis and management of child abuse Upon completion of the case, I am more aware of the professional role with doctors have in the diagnosis and management of cases of suspected abuse

In order to provide further evidence of content validity, academic staff from the Department of Paediatrics and Medical Education were asked to comment on individual items in relation to accuracy, clarity and style. Items were modified based on expert review.

3.13.2.3 Instrument

The final 12 statements that were included were designed using a likert scale. Each statement was scored on a five-point likert scale, such that a participant strongly agreeing with a 'positive' statement, or strongly disagreeing with a 'negative' statement, was given a score of '5'. Conversely, a participant strongly disagreeing with a 'positive' statement, or strongly agreeing with a 'negative' statement, was given a score of '1'. All scores were summed to obtain an overall 'Virtual Patient score'. The possible range of scores for the questionnaire was 12 to 60.

3.13.2.4 Final questionnaire instrument (Figure 3.13.2.4)

Figure 3.13.2.4 Final questionnaire instrument

- The learning goals for the module were clearly stated
- The module did not reflect real life situations
- I would like to see similar modules throughout the course
- The module was sufficiently interactive
- The expert comments provided useful additional information
- The learning activities (Reflection boxes, quizzes etc.) were well integrated into the module
- The module helped me to reflect on professional issues
- Working through the module was a valuable use of my time
- Child abuse is not an important issue for undergraduate training in paediatrics
- The module helped me identify deficits in my knowledge
- Upon completion of the module, I am more aware of the difficulties surrounding the diagnosis and management of child abuse
- Upon completion of the case, I am more aware of the professional role that doctors have in the diagnosis and management of cases of suspected abuse

3.13.2.5 Completion of questionnaire

Immediately after completion of the module, all students were invited to fill in the questionnaire which was embedded in the online Virtual patient module.

3.13.3 Evaluation 3: Trainee evaluation of the Virtual Patient module used to facilitate a case based discussion

3.13.3.1 Rationale

Although the Virtual Patient module was developed for use by undergraduate medical students, the author also wanted to determine whether it had a role to play in teaching postgraduate trainees (Basic Specialist Trainees) and whether it could be used to facilitate a group discussion, in addition to its use as a self-study module. The online questionnaire was therefore modified to include statements relevant to Basic Specialist Trainees and the mode of delivery of the module.

3.13.3.2 Participant recruitment

All Basic Specialist Trainees attending a Basic Specialist Trainee study day on non-accidental injury at the Royal College of Physicians of Ireland were invited to participate in the case discussion. A total of 25 trainees attended the study day and participated in the case discussion.

3.13.3.3 Conduct of case discussion

Over a 1-hour period, the trainees watched the online video scenes and completed the module, collectively addressing the questions and scenarios. All participants were encouraged to give their opinion and comment freely on the content.

3.13.3.4 Questionnaire

At the end of the session, all participants were asked to complete a paper version of the modified evaluation questionnaire. Respondents were asked to rate their agreement with 18 statements on a 1 to 4 likert scale.

3.13.4 Research sub-question 2.2: Clinical Knowledge gain

Does an online Virtual Patient module improve students' short-term and long-term clinical knowledge and how is this influenced by the instructional methods used?

3.13.4.1 Rationale

In order to determine whether the online Virtual Patient module improves students' clinical knowledge, there was a need to assess their knowledge of the recognition and management of child abuse both pre and post completion of the module. MCQ examinations are a reliable, widely used form of assessment in undergraduate education. All RCSI students had been assessed by MCQs in previous examinations and therefore were familiar with their format.

As participation in the module was voluntary, the author did not anticipate that students would agree to retake the MCQ at a later date, in order to assess their long-term knowledge gain. Therefore, a problem-based learning question on child abuse was included in the students' final year paediatric examination to assess whether students retained knowledge. This also enabled comparison of long-term knowledge retention between students who had completed the traditional curriculum alone and those who had completed both the Virtual Patient and the traditional curriculum.

3.13.4.2 Pre and post module MCQ

MCQs used the true/false and best of five structures. The maximum obtainable score was 22. The examination dealt with content covered directly or indirectly in the module. Eight questions assessed knowledge of information that was presented directly in the module i.e. in the form of information text boxes. The remaining eleven questions assessed information that was presented indirectly, i.e., visually and auditory, through the use of interactive video scenarios.

3.13.4.3 Data collection

All answers were automatically saved, anonymized and stored on a password-protected data-base.

3.13.4.4 Child abuse problem-based learning question

One question on the final paediatric End of Year (EOY) examination problem-based learning written paper was concerned with the recognition and management of suspected child abuse. The child abuse question consisted of four parts, based on content addressed both directly and indirectly in the Virtual Patient module and covered in the traditional curriculum.

- Parts 1 and 2 were concerned with the recognition of suspected child abuse (in the Virtual Patient module, this information was presented in text format).
- Parts 3 and 4 were concerned with the management of suspected child abuse (in the Virtual Patient module, this information was presented through audio and visual means).

3.13.4.5 Data collection

Student answers to the child abuse problem-based learning question were marked using a standardised scoring system. Anonymised results were then made available for analysis and inclusion in the study.

3.13.5 Research sub-question 2.3: Professional identity

Do Virtual Patients have a role to play in the development of students' professional identities?

3.13.5.1 Rationale

In order to determine whether Virtual Patients have a role to play in the development of students' professional identities the author decided to evaluate whether giving

feedback to students during the course of the module influenced their subsequent responses to professional dilemma scenarios.

3.13.5.2 Professional dilemma scenarios

Three of the video scenarios in the Virtual Patient module depict a dilemma concerning professionalism. The video scenes were scripted to depict difficult situations described in previous published reports, which a trainee might encounter in clinical practice.

The scenarios focussed on:

1. Handling uncertainties regarding medical knowledge and responsibilities
2. Dealing with criticism from others
3. Working with colleagues

3.13.5.3 Pre set answers

Academic staff from the Department of Paediatrics reviewed the video scenarios and agreed on what they considered to be an appropriate response. For each video scenario a pre-determined set of answers was developed, the ideal answer and 2-3 distractors. Options were presented in multiple-choice format similar to situational judgement tests. Following selection of an answer, students were provided with feedback on the response explaining the rationale behind whether the answer was considered ideal or not.

3.13.5.4 Validation of pre set answers

In order to further establish the validity of the pre-set answer, Senior House Officers (SHOs), completing their Basic Specialist training in paediatrics, were invited to participate in the Virtual Patient module online. The author considered SHOs the ideal cohort to confirm responses, as the video scenarios deal with situations that trainees early in the course of their clinical training may encounter in clinical practice.

3.13.5.5 Undergraduate student and postgraduate trainee responses analysis

The frequency of providing the best response to the dilemma and the number of attempts taken to reach the ideal answer were recorded.

3.13.6 Research sub-question 2.4: Reflective practice

Do Virtual Patients promote reflective practice?

3.13.6.1 Rationale

In order to answer this research question, an instrument that could be used to measure reflective skills needed to be developed. After reviewing the literature, the author chose to adapt a semi-structured observer-rated instrument developed by Boenink et al. in 2004.¹⁹¹ The instrument had been developed to measure reflection on professionalism in medical practice by utilising paper-based case-vignettes. The author concluded that the instrument could be adapted for measuring student responses to video-based reflection scenes in the Virtual Patient module. In addition, the study sought to determine whether deeper reflection could be promoted by providing guidance on reflective practice.

3.13.6.2 Reflection scenes

The Virtual Patient module consists of 6 interconnected video scenarios that deal with professionalism. The video scenarios depicted various professional dilemmas that students were asked to reflect upon.

3.13.6.3 Introducing reflection into the module

As the author was aware that many students might not be familiar with reflective practice, a passage at the start of the module that explained the importance and benefits of reflection was included. In addition, an example of a 'model reflective passage was included after the first scene to assist students' understanding of the process of reflection and the areas they should attempt to explore in their own writing. (Figures 3.13.6.3a and b)

Figure 3.13.6.3a Information provided to students on reflective practice

Throughout the online Virtual Patient, there will be opportunities for you to reflect. The ability to reflect on educational and clinical experiences in medical practice is an important skill for you to master. In order for doctors to maintain and improve their clinical performance they must have insight into the problems that can occur, be able to relate them to their own professionalism and make appropriate judgements. In addition, studies have shown that greater reflective activity in learning is correlated with better performance in examinations.

But what is reflection? Reflection is the process of actively and consciously engaging with experiences in order to learn from them. An excellent reflective account should present a balanced approach, consider all the relevant perspectives, acknowledge uncertainties or dilemmas, and provide insight into the effect that the experience has had on your current and future learning.

Figure 3.13.6.3b Model reflective practice passage provided to students

How do you think the nurse handled the situation?

.....I think it's a difficult situation for the nurse to be in, she has raised her concerns to Amy, however, Amy did not seem to realise the significance of the bruises. I think that the nurse should follow up the case to ensure that the child is not sent home without further investigation. However, for the nurse, it may be a very difficult situation to deal with. Her decision whether or not to follow up on the case will probably be based on her previous experience, her concern for the child, her confidence and her relationship with not just Amy but also her fellow colleagues. I think it would be difficult for her to 'go over' Amy's head and report the case to a more senior staff member, and perhaps she feels she has done her part. However, her responsibility is to the child, so even though it may strain the relationship which she has with Amy and perhaps with other junior doctors in the Emergency Department I think she needs to take the matter further. Amy was very dismissive towards the nurse, and I guess I was quite surprised that the nurse accepted Amy's comments that the child was fine, when clearly the nurse had concerns. However, the nurse may not be experienced, and perhaps Amy has a very good reputation of being an excellent doctor and so the nurse accepts her decision to ignore the bruises. I think it's important to remember that in clinical practice, we can miss things and certainly the scene highlights how all healthcare professionals need to work together as a team, that it is everyone's responsibility and we all have a role to play in ensuring that children are cared for appropriately. If I was the nurse in this situation, I would not be comfortable accepting Amy's decision.....

3.13.6.4 Student groups

Students were divided into two groups, based on the order in which they completed their paediatric rotation. Group A refers to the non-intervention group and Group B refers to the intervention group.

3.13.6.4.1 Group A (non-intervention)

Students in groups A were prompted to reflect on the video by use of an open-ended question only. They were asked the following questions after viewing the video scenes.

- How do you think the consultant radiologist handled the situation?
- How do you think the consultant handled the situation?
- How do you think Amy handled the situation?
- Do you think the consultant behaved appropriately towards Amy?
- How do you think you would cope in this situation?

3.13.6.4.2 Group B (intervention group)

In order to determine whether the intervention could facilitate better student engagement with the reflective cycle and encourage students to understand and analyse professionalism, students in group B were provided with a framework to help structure their thoughts. The framework was developed to help clarify their opinions and explore different ideas and perspectives. As no existing model was appropriate, the author decided to use the eight components of professionalism endorsed by the American Board of Paediatrics; honesty and integrity, reliability and responsibility, respect for others, compassion/empathy, self improvement, self awareness/knowledge of limits, communication and collaboration, and finally altruism and advocacy.²¹⁹

3.13.6.5 Expected outcomes

Based on the findings outlined in the literature review, it was expected that female students, students who had completed a previous degree and academically higher

performing students would be more reflective than male students, students who had not completed a previous degree prior to entering medical school and academically weaker students, respectively. In addition, it was expected that providing guidance would promote deeper engagement with the reflective cycle.

3.13.6.6 Instrument scoring system

In the study, the steps used by Boenink et al. were followed.¹⁹¹ First, the perspectives that were named were scored. Scores were allocated for each predefined perspective according to whether it was named, and if so how extensively it was mentioned. A score of 0 was given for not mentioning the perspective at all, a score of 1 was given for mentioning it at least once, and a score of 2 was given for mentioning the perspective extensively. In order to make the perspectives applicable to the study's educational setting and to the case vignettes, a number of modifications were made to the perspectives. For example, Boenink et al. refer to 'Clerks' and since in Ireland, as we do not use this term, it was omitted. (Figure 3.13.6.6)

Figure 3.13.6.6 The 12 General Perspectives

General perspectives

1. **The medical situation:** Are medical considerations mentioned? For example; further investigations needed, cause of fractures, treatment, history
2. **The medico-legal perspective:** This is scored when medico-legal considerations are mentioned explicitly or implicitly, for example 'the child needs to be admitted'
3. **Professionalism:** To be scored when student addresses explicitly professional behaviour e.g. 'she acted unprofessional'
4. **The ethical perspective:** To be scored when an ethical dilemma is expressed or ethical terms are mentioned. For example 'the safety of the baby is of utmost importance' or 'need to protect the child'

Perspectives of others

5. **The patient perspective:** To be scored for all considerations in which something is stated about the (supposed) experiences or perception of the patient. For example 'the child may still be at risk'
6. **The family perspective:** To be scored for all considerations in which something is stated about the mother or the family e.g. 'didn't respect the mother' or 'the mother may be having a difficult time at home'
7. **The perspective of the doctors involved in the situation:** To be scored for all considerations in which something is stated about the doctor e.g. 'she was confrontational' or 'she was accusatory'
8. **The perspective of the nurses and / or other healthcare workers:** To be scored for all considerations in which something is stated about other health professionals e.g. 'social workers need to be contacted' or 'the consultant needs to be informed'

Specific contextual factors

9. **The educational perspective:** To be scored when the education of medical students, doctors or other health professional are mentioned.
10. **Hierarchical position:** To be scored when the hierarchical position of a certain health professional is specifically mentioned as generating certain considerations. For example 'this is a case for the supervisor to decide on.'

Personal perspectives

11. **Personal opinions, norms, values, viewpoints:** To be scored when statements are made without motivation or argumentation. For example 'I think that..' or 'in my opinion' or 'this is or that should be done'.
12. **Personal feelings:** To be scored when the subject's emotions-such as uncertainty, anger or pride are expressed. Statements in which feelings are conveyed without being explicitly mentioned must also be scored here. For example 'this is my lucky day!!'

Secondly, an overall score for the degree of reflection shown in the written response was given. According to Boenink et al. overall scores will be higher when:¹⁹¹

- A variety of perspectives are mentioned
- More comparative assessments are shown
- Contradictory considerations are explicitly mentioned
- Personal considerations are related to general perspectives (Table 3.13.6.6)

Table 3.13.6.6 Scoring instructions for overall reflection scores

1-2	Oversimplified, intolerant opinion, only emotional reaction
3-4	Limited / restricted, narrow viewed, one-sided reaction, mostly just one perspective, no weighing or balancing, no attention paid to context
5	More than one perspective, but neither balancing nor attention paid to context
6-7	More perspectives, general as well as personal, some balancing between perspectives
8-9	Differentiated balancing, room for dilemmas or doubt, explicit attention paid to the patient
10	A subtle / balanced approach, considering all relevant perspectives, weighing different interests, having a keen eye for dilemmas and uncertainties, paying attention to the patient's viewpoint and evaluating one's own position and latitude

3.13.6.7 Data analysis

The relationship between the overall reflection score and the 12 perspectives was analysed for each reflection scenario using Spearman rank correlation. An independent sample T-test was used to analyse the difference in overall reflection scores between Group A (non-intervention) and Group B (intervention). The answers were scored by two independent raters (MMM and EMH). Each scored the individual answers to all scenes. The raters were unaware of all independent variables (gender, examination scores, degree status).

3.13.6.8 Reflectors versus non-reflectors

The relationships between gender, academic performance, age and degree status were explored to look for differences between students who reflected at least once (reflectors) and those who failed to document any reflective account (non-reflectors).

Differences between students who had received guidance on reflection and those who had not were analysed.

3.14 Summary

In order to establish the suitability of Virtual Patients for the education of undergraduate students and postgraduate trainees, a mixed-method approach is the most appropriate. The first step is to establish the current situation and to determine whether the current curriculum in paediatrics requires augmentation. This will be done by reviewing student logbooks. This will determine what clinical cases students are gaining exposure to and where deficits might exist.

A Virtual Patient module dealing with a case of suspected child abuse will be developed incorporating clinical knowledge, professional 'norms' and reflective capabilities. In order to assess the module and answer the study's second research question, a series of interconnected studies will be undertaken. The first will assess the acceptability of the Virtual Patient by triangulating data from three separate evaluations; (i) undergraduate student focus groups; (ii) undergraduate student and (iii) postgraduate trainee questionnaire responses.

In order to determine whether the Virtual Patient module increases short and long-term acquisition of clinical knowledge and to assess the impact of the instructional method use on this, a pre- and post-module MCQ will be used. A prospective comparison of end of year examination results, comparing students who completed the module and those who chose not to, will be conducted.

The impact of the Virtual Patient module on the development of students' professional identities will be assessed by examining student responses to professional scenarios within the Virtual Patient module will be analysed and the role of feedback in helping students understand professional 'norms' will be assessed.

Finally, a semi-structured observer rated tool will be used to determine whether Virtual Patients promote reflective practice and support deeper engagement with the reflective cycle in students.

Chapter 4

Results

4.1 Introduction

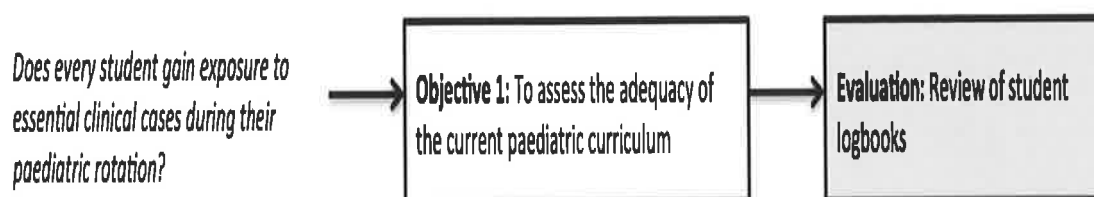
In this chapter the results of the thesis will be presented. Firstly, the results of the student logbook analysis that was undertaken to assess the adequacy of the current paediatric curriculum will be presented. Next, the results of the four separate evaluations that were conducted to determine whether Virtual Patients are an effective learning tool will be presented.

4.2 Research Question 1: Assessment of adequacy of current paediatric curriculum

Based on an evaluation of current undergraduate training, is there a need to supplement the traditional undergraduate paediatric curriculum to ensure students receive equivalent educational experiences to one another?

4.2.1 Point in study flow sheet (Figure 4.2.1)

Figure 4.2.1 Point in study flow sheet: Research question 1



4.2.2 Number of cases seen by sub-speciality and diagnosis

224 student logbooks were reviewed, describing an average of 18.74 cases per student. A total of 4,199 cases were seen, accounting for 160 different diseases and presenting symptoms or signs. The commonest sub-specialities seen were respiratory, gastroenterology and neurology accounting for 23%, 14% and 10%, respectively, of the total number of cases. The top five cases seen were gastroenteritis, bronchiolitis, asthma, viral upper respiratory tract infections and pneumonia, accounting for over 25% of the total cases seen. (Figure and table 4.2.2)

Figure 4.2.2 Graph of number of cases seen by sub-specialty

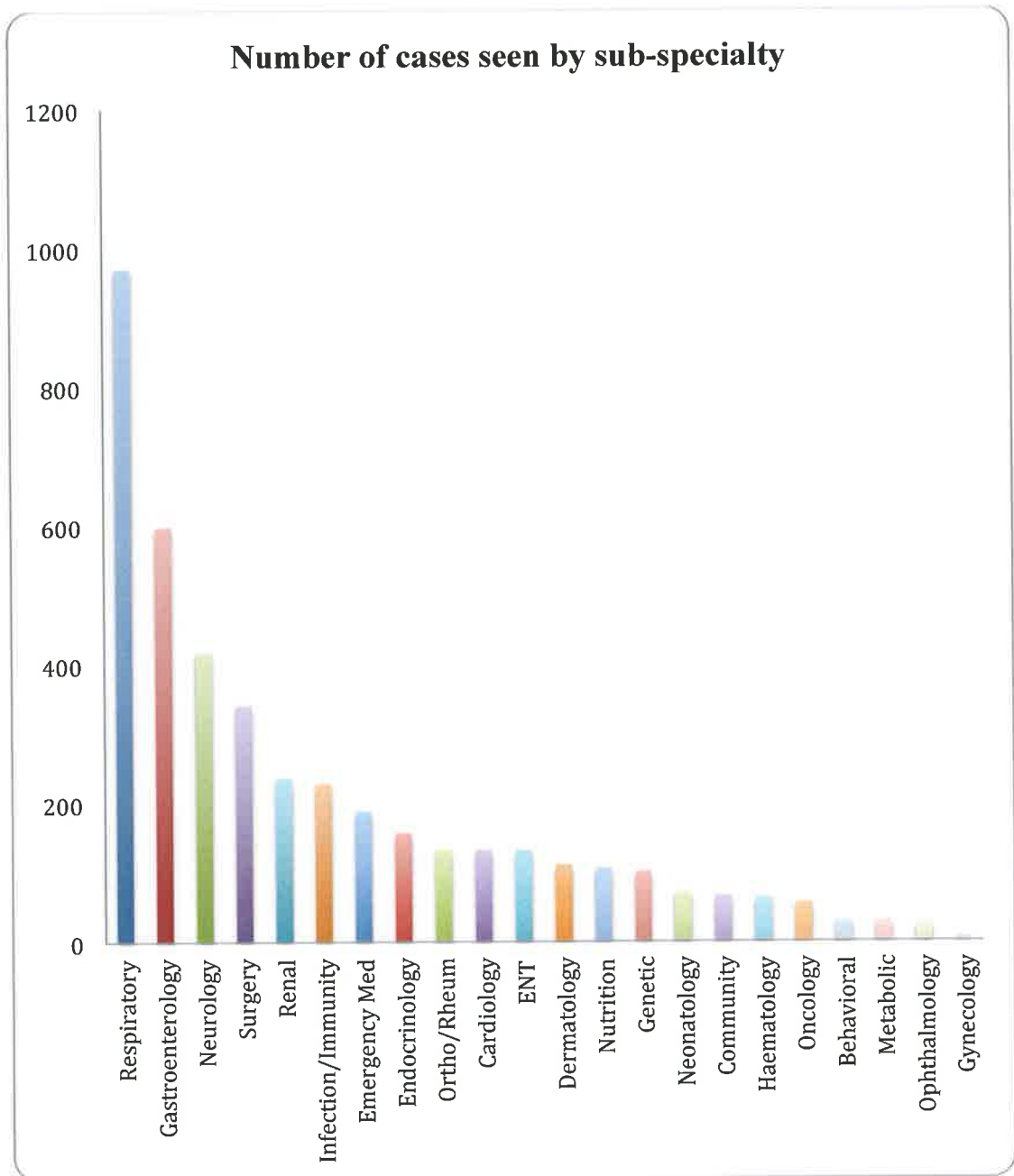


Table 4.2.2 Number of cases seen by sub-specialty

Speciality	Min	Max	Mean	Standard deviation
Total Number	8	21	18.75	2.04
Respiratory	0	12	4.33	2.12
Gastroenterology	0	8	2.67	1.77
Neurology	0	10	1.87	1.62
Surgery	0	8	1.52	1.39
Renal	0	6	1.05	1.11
Infection/Immunity	0	5	1.02	1.03
Emergency Med	0	4	0.84	0.95
Endocrinology	0	4	0.70	0.90
Ortho/Rheum	0	6	0.59	0.89
Cardiology	0	6	0.59	0.95
ENT	0	5	0.59	0.85
Dermatology	0	5	0.50	0.81
Nutrition	0	4	0.47	0.67
Genetic	0	4	0.45	0.80
Neonatology	0	3	0.32	0.59
Community	0	2	0.29	0.57
Haematology	0	5	0.28	0.67
Oncology	0	5	0.25	0.67
Behavioural	0	2	0.13	0.38
Metabolic	0	3	0.13	0.45
Ophthalmology	0	2	0.12	0.34
Gynaecology	0	1	0.03	0.16

4.2.3 Academic staff ranking of diseases or presenting signs and symptoms

Of the 160 different diseases or presenting signs and symptoms seen, academic staff ranked 54 cases as essential, 60 as desirable and 46 as optional. (Table 4.2.3)

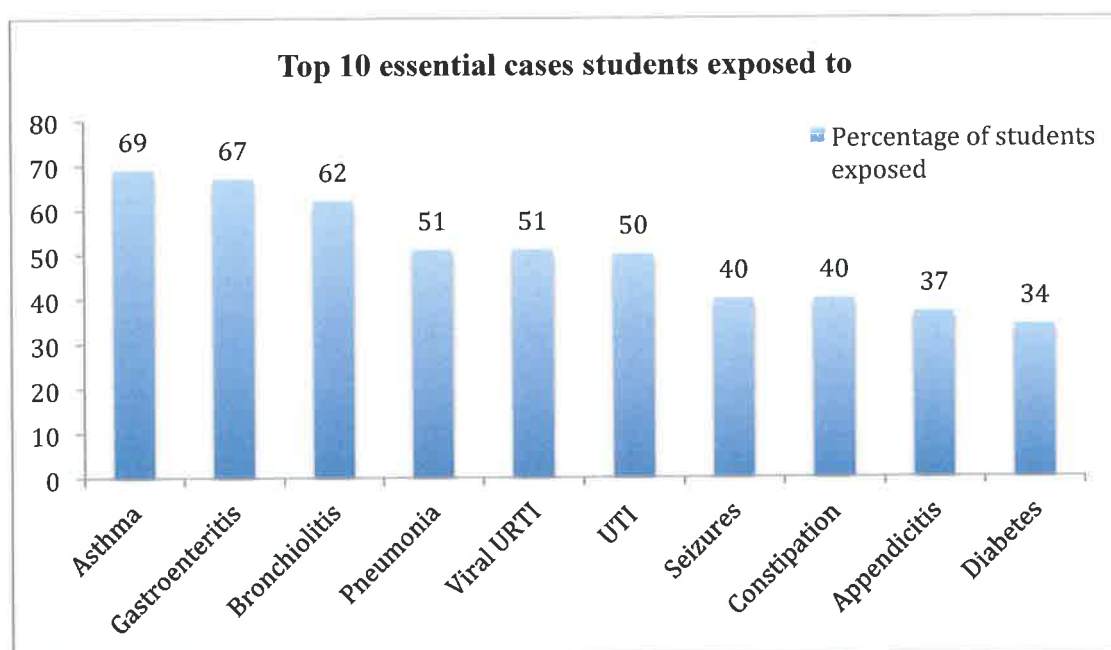
Table 4.2.3 Academic ranking of cases

Importance ranking	Number of cases
3 (essential)	54
2 (desirable)	60
1 (optional)	46

4.2.4 Average percentage of students gaining exposure to essential cases

The average percentage of students who were exposed at least once to the essential cases, as determined by the academic staff, was determined by dividing the number of students who were exposed at least once to the essential cases by the total number of students who completed the log book. This gave information about the average percentage of students gaining exposure to a given diagnosis or presenting sign or symptom. The commonest essential condition to which students were exposed to was asthma (69.3%), with just 0.9% of students gaining exposure to colic, common nappy rashes and normal infant findings. The average exposure to essential cases was 18.73%. (Figure 4.2.4)

Figure 4.2.4 Graph of top 10 essential cases students exposed to



Based on the number of cases they are required to document, if less than 37% of students reported at least one exposure to a case it was considered inadequate. A minimum of 9 cases seen was thus considered necessary for a case to have been appropriately covered by students.

4.2.5 Relationship between the number of unique cases seen and components of end of course (EOC) and end of year (EOY) examination

The mean number of unique diagnoses or presenting signs or symptoms was 14.75 (SD 2.26) cases per student. The relationships between the number of unique cases seen and end of course (EOC) and end of year (EOY) examination results were investigated using Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure assumptions of normality, linearity and homoscedasticity were met. There was a weak positive correlation between total number of unique cases seen and the EOC mark, EOY Clinical case 1 and the students Final Paediatric mark. ($r=0.15$, $p<0.022$, $r=0.133$, $p<0.048$, $r=0.141$, $p<0.036$, respectively). (Table 4.2.5)

Table 4.2.5 Correlation between number of unique cases seen and components of EOC and EOY examination

	EOC MCQ	EOC written	EOC Clinical	EOC overall mark	EOY Clinical case 1	EOY Clinical case 2	EOY Clinical mark	EOY Overall mark
Pearson Correlation	0.12	0.09	0.1	0.15	0.13	0.04	0.1	0.14
P value	0.09	0.16	0.16	0.02	0.05	0.51	0.16	0.04

4.3 Study participant demographics

A total of 181 students completed the entire module (Response rate 81%). Data were available on the age of 177 participants and the mean age was 24.7 years. 49.7% of participants were male ($n=90$) and 50.3% were female ($n=91$). Although 34% of participants were Irish, there was a diverse range of nationalities represented, reflecting the international student profile of the institution. Only 21.5% ($n=39$) students had seen cases of suspected child abuse during their clinical rotations. Information on possible previous degrees was available for 160 students, of whom only 50 had completed a degree before entry to medical school. At the end of the academic year, 222 students sat the final paediatric written examination. Of those, 176 had completed the Virtual Patient module (response rate= 79%). (Table 4.3)

Table 4.3 Demographics of study participants

Age of participants	N	Minimum	Maximum	Mean	Std. Deviation
Age	177	20.00	38.00	24.7627	2.92524

Gender	Frequency	Percent
Male	90	49.7
Female	91	50.3

Cases of suspected child abuse seen during paediatric rotation	Frequency	Percent
No	142	78.5
Yes	39	21.5

Nationality	Frequency	Percent
Ireland	59	32.6
All other countries	122	67.4

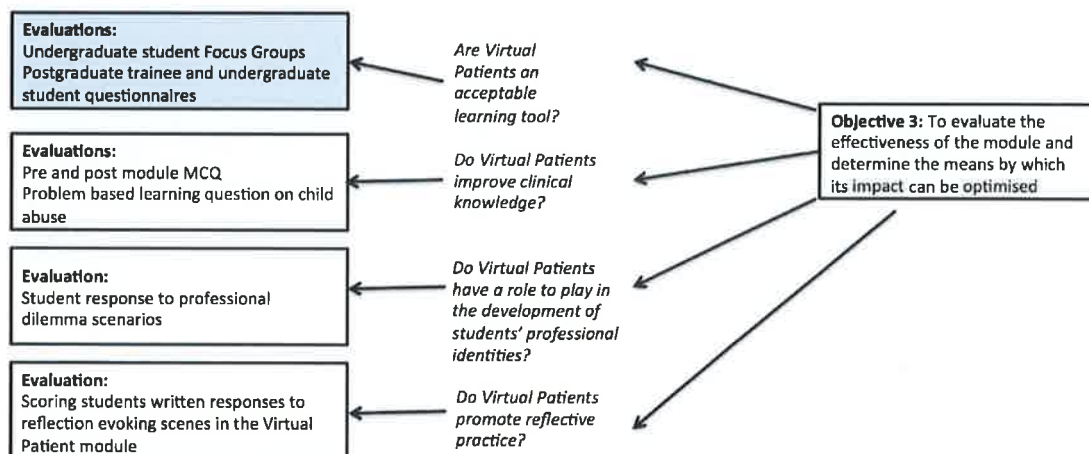
Degree Status	Frequency	Percent
Information not available	21	11.6
Completed previous degree	50	27.6
Undergraduate entrant	110	60.8

4.4 Research sub-question 2.1: Acceptability

Do undergraduate students and postgraduate trainees view an online Virtual Patient module as an acceptable learning tool?

4.4.1 Point in study flow sheet (Figure 4.4.1)

Figure 4.4.1 Point in study flow sheet: Research question 2.1



4.4.2 Focus group evaluation of undergraduate paediatric medical students

4.4.2.1 Students learn from engaging learning resources

Following completion of the online module, all students agreed that the Virtual Patient had helped them learn more about child abuse than reading about it in a book or attending a lecture or tutorial. *'I would choose it over any other way to learn, I mean who would want books or lectures when you have this.'* Students valued the Virtual Patient as a learning resource because it was engaging and it held their interest from start to finish as it told a real life story in an authentic way. *'It was great having actors, I thought it was real, I was convinced she was an intern that works at Beaumont!'* *'It was relaxing, that you could watch a video and it was called learning.'* Learning from clinical cases has always been the cornerstone of medical education. However, for most students opportunities to follow cases from their initial presentation to subsequent discharge from hospital is hampered by short, intense rotations. They often see only snapshots of a child with condition X in the Emergency Department and a child being treated for condition Y on the wards. Continuity made the Virtual Patient module engaging. *'The story keeps you involved and entertained, you enjoy and learn from it so much more when there is a story compared to lets say just a series of unrelated clips'*. All students had used various online learning resources in the past and found the Virtual Patient easy to interact with.

4.4.2.2 Virtual Patients allow participation

Students recognised that child protection cases are particularly challenging, even for experienced clinicians. Attempts to learn about the complex interplay of medical diagnostics, legal evidential issues, ethical concerns and professional responsibilities required to ensure the safety of children cannot be understood when learning is divorced from clinical reality. Students learned from the Virtual Patient module because it depicted real people in an actual clinical setting and told a story that they were allowed to be part of. *'You get a chance to see how people can behave, how things can go wrong, what to do when you are challenged or unsure'*. As one student commented *'We never get to see things like this'*. The Virtual Patient allowed students to participate, albeit in a virtual environment, in a case that they would

otherwise never have been exposed to. Students acknowledged that, even if they were fortunate enough to have clinical exposure to a case, they felt that, as a student, their level of involvement would be minimal. *'NAI was perfect because it's something really important which we don't get to see during our 6 week attachment'*. Only one student had been involved in a case of suspected child abuse during the course of the paediatric rotation. *'I did have a case of NAI which I saw and I knew something wasn't right with the history, it just didn't fit, I think I learned that because of the Virtual Patient.'* All students recognized that child abuse was an important topic for them to learn about and agreed that depicting a case of suspected child abuse through virtual means was a valuable learning resource.

4.4.2.3 Integrating clinical knowledge into the module assists learning

Within the module, there are various information boxes, picture quizzes and interactive questions with feedback. The learning materials are aligned with the videos. For example, after the scenario in which the lead character, Amy, the SHO, attempts to interpret a CXR, there are opportunities for students to do the same, with focussed feedback. The students felt that their ability to memorize clinical knowledge was increased because of the real life scenario in which the information was presented. *'I think it should integrate even more clinical knowledge because you remember it so much more when it's presented in this way'*. Presenting relevant information that students were able to link to a real life case enhanced their learning. *'It sticks in your head more', 'It's such a great way to learn you always remember'*. Students felt that their ability to understand and learn the material was enhanced as the scenarios and associated learning materials helped them establish connections and build upon their prior knowledge.

4.4.2.4 Reliability of Virtual Patient modules

The students acknowledged that during the course of their training they often become overwhelmed by the amount of material they have to learn and the variety of learning resources available. Before exams, they lack confidence in their preparation as they feel their coverage of a particular topic or disease may not be broad enough to allow them to answer all questions. As one student commented, *'Wouldn't it be great if all you needed to know was in one neat package'*. In order for students to invest time

and effort in a learning resource they need assurance that the module is comprehensive and exam focussed. *'I'd like to just do it, one online tutorial that covers all I need to know.'* The strength of the Virtual Patient module was its comprehensive coverage of their curricular requirements. *'It certainly helped me learn for the exams', 'I felt prepared'*. However, one of the concerns the students voiced regarded the length of the module. For many students, completion of the entire module, including responding to the reflection boxes, had taken over an hour. As one student commented *'It's kind of a compromise; to be short enough and yet comprehensive'*. Students failed to reach consensus on the ideal module length. Although some recognised that *'The key to learning is repetition'*, others argued that *'but you remember so much from watching the video when you only see it once, so it's worth a little bit of extra time'*.

4.4.2.5 Integration

All students recognized the dual purpose of the Virtual Patient: (i) to help them attain clinical knowledge and (ii) gain an understanding of the professional role of doctors in dealing with cases of suspected child abuse. The students recognized integration as critical to the success of learning about professionalism through virtual means. All students wanted professionalism teaching to be integrated, rather than treated as an isolated module in the curriculum. In the Virtual Patient module, the students see contrasting ways in which a single case of suspected child abuse could be managed. They valued seeing both 'the ideal' and 'the disaster' scenario. They felt that both positive and negative experiences contributed to their understanding of professionalism. In the Virtual Patient module, various professional dilemmas are presented. The student response determines whether the junior doctor or the consultant addresses the possible abuse. During the focus group, students highlighted how the module contributed to their personal and professional development. *'I learned, that it's important to seek help, that's my long lasting take home message', 'the Virtual Patient helps you remember all the clinical information about NAI, but you still pick up all the rest (professional aspects)', 'I learned how to cope with difficult situations, to ask myself how I would deal with it, I guess it helps prepare for what is to come ahead'*. Students recognised the importance of professional development, but acknowledged that they are extremely exam focussed. The integration of professionalism into the module was, therefore, highly valued as it

encouraged consideration of professional norms and contributed towards students' personal and professional development. *'It's so much better when it is presented this way, so then we can be taught both (clinical knowledge and professionalism) side by side but still satisfy our primary focus of exams.'*

4.4.3 Psychometric properties of evaluation questionnaire

4.4.3.1 Reliability of questionnaire

Reliability refers to the ability of a research instrument to measure phenomena in a consistent way over time. There are several measures that can be undertaken to measure reliability:

1. Cronbach's alpha reliability
2. Kuder-Richardson reliability
3. Kappa coefficient of concordance
4. Kendall coefficient of concordance
5. Inter-rater reliability
6. Split half reliability
7. Alternate form reliability
8. Test-retest reliability

As the Kuder-Richardson formula is a measure of internal reliability for measures with dichotomous choices, it was not an appropriate method to use as the evaluation questionnaire used a likert scale. Neither were inter-rater reliability, Kappa coefficient nor Kendall coefficient of concordance appropriate as no observers were used. As student participation in the online module was voluntary and did not contribute to their formative or summative assessment, it was considered inappropriate to ask the students to retake the questionnaire, as it was assumed that the response would be low.

Cronbach's alpha is a measure of the internal consistency of the test being carried out. It works by assuming that test items are positively correlated, i.e. each item contributes to the overall measurement of the same factor. Factor loadings can estimate the contribution of individual items.²²⁰ The reliability of the questionnaire was assessed using Cronbach's alpha for both the whole questionnaire and for each item using the 'alpha if item deleted' to identify any rogue questions. Satisfactory values were obtained for the questionnaire with a value of 0.805 for the 12 items. (Table 4.4.3.1)

Table 4.4.3.1 Cronbach's alpha score for questionnaire

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.773	.805	12

Question 9 was omitted from analysis as its exclusion led to a higher Cronbach's alpha score of 0.835. Further analyses in this paper have been presented using the remaining 11 items. Factors 1 (The impact on learning) and Factor 2 (Module content and structure) showed a Cronbach's alpha of 0.8 and 0.7 respectively.

4.4.3.2 Correlation coefficients

Spearman's rank correlation coefficient for each item individually against the total Virtual Patient score ranged from 0.424 to 0.745. A perfect correlation of 1 or -1 indicates that the value of one variable can be determined exactly by knowing the value of the other variable. Correlations above 0.6 were considered to have a moderate to strong relationship. (Table 4.4.3.2)

Table 4.4.3.2 Correlation of each questionnaire item to overall Virtual Patient questionnaire score

Questionnaire Item		1	2	3	4	5	6	7	8	9	10	11	12	Total
1	rho	1.00	0.26	0.30	0.37	0.32	0.16	0.38	0.20	0.11	0.24	0.32	0.31	0.54
	Sig.	.	0.00	0.00	0.00	0.00	0.03	0.00	0.01	0.16	0.00	0.00	0.00	0.00
2	rho	0.26	1.00	0.25	0.14	0.18	0.11	0.27	0.11	0.12	0.13	0.20	0.21	0.42
	Sig.	0.00	.	0.00	0.06	0.01	0.14	0.00	0.13	0.10	0.09	0.01	0.00	0.00
3	rho	0.30	0.25	1.00	0.44	0.40	0.29	0.33	0.56	-0.13	0.24	0.27	0.40	0.66
	Sig.	0.00	0.00	.	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00
4	rho	0.37	0.14	0.44	1.00	0.51	0.43	0.33	0.27	0.00	0.29	0.36	0.44	0.60
	Sig.	0.00	0.06	0.00	.	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.00
5	rho	0.32	0.18	0.40	0.51	1.00	0.33	0.35	0.26	0.10	0.30	0.44	0.45	0.57
	Sig.	0.00	0.01	0.00	0.00	.	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00
6	rho	0.16	0.11	0.29	0.43	0.33	1.00	0.39	0.33	-0.04	0.32	0.31	0.39	0.56
	Sig.	0.03	0.14	0.00	0.00	0.00	.	0.00	0.00	0.64	0.00	0.00	0.00	0.00
7	rho	0.38	0.27	0.33	0.33	0.35	0.39	1.00	0.36	0.06	0.49	0.56	0.76	0.69
	Sig.	0.00	0.00	0.00	0.00	0.00	0.00	.	0.00	0.43	0.00	0.00	0.00	0.00
8	rho	0.20	0.11	0.56	0.27	0.26	0.33	0.36	1.00	-0.05	0.30	0.32	0.40	0.61
	Sig.	0.01	0.13	0.00	0.00	0.00	0.00	0.00	.	0.49	0.00	0.00	0.00	0.00
9	rho	0.11	0.12	-0.13	0.00	0.10	-0.04	0.06	-0.05	1.00	0.13	0.11	-0.05	0.05
	Sig.	0.16	0.10	0.09	0.98	0.19	0.64	0.43	0.49	.	0.08	0.16	0.55	0.54
10	rho	0.24	0.13	0.24	0.29	0.30	0.32	0.49	0.30	0.13	1.00	0.50	0.48	0.54
	Sig.	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.08	.	0.00	0.00	0.00
11	rho	0.32	0.20	0.27	0.36	0.44	0.31	0.56	0.32	0.11	0.50	1.00	0.65	0.67
	Sig.	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	.	0.00	0.00
12	rho	0.31	0.21	0.40	0.44	0.45	0.39	0.76	0.40	-0.05	0.48	0.65	1.00	0.75
	Sig.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00	.	0.00
Total	rho	0.54	0.42	0.66	0.60	0.57	0.56	0.69	0.61	0.05	0.54	0.67	0.75	1.00
	Sig.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	.

4.4.3.3 Factor analysis

Factorability of the remaining 11 Virtual Patient Questionnaire items was examined. The 11 items of the scale were subjected to Principal Component Analysis (PCA) using SPSS version 18. Prior to performing PCA, the suitability of the data for factor analysis was assessed. Inspection of the correlation matrix revealed many coefficients of 0.3 and above. The Kaiser-Meyer-Olkin value was 0.843, exceeding the recommended value of 0.6²²¹, demonstrating that there are significant factors to be derived from the data. In addition, the Bartlett's Test of Sphericity²²² reached statistical significance ($p < 0.0001$) supporting the factorability of the correlation matrix. (Table 4.4.3.3a)

Table 4.4.3.3a KMO and Bartlett's Test

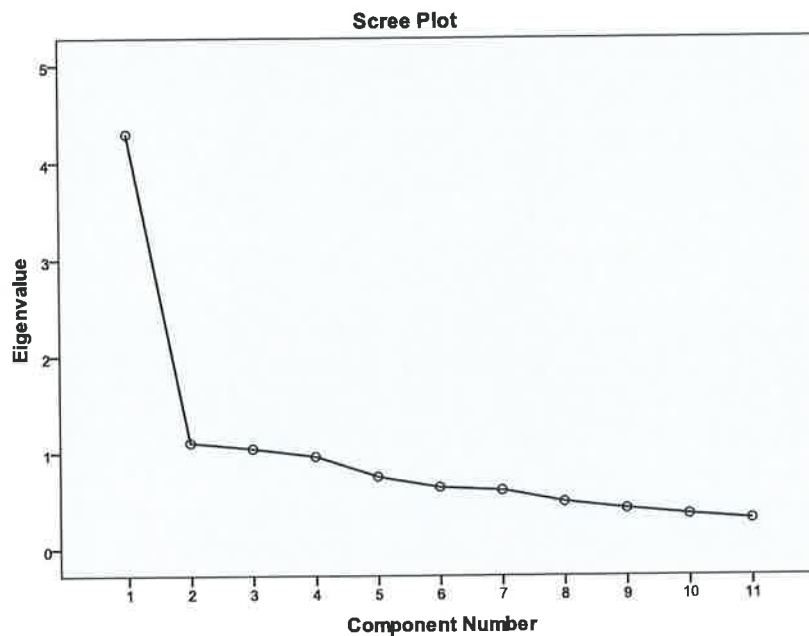
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.843
Bartlett's Test of Sphericity	Approx. Chi-Square	600.752
	df	55
	Sig.	.000

The number of factors to be retained can be guided by three decision rules:

- Kaiser's criterion (eigenvalues above 1)
- Inspection of the scree plot
- The use of Horn's parallel analysis²²³

Principal Component Analysis revealed the presence of three components with eigenvalues exceeding 1, explaining 39.836%, 11.04% and 10.271% of the variance respectively. An inspection of the scree plot revealed a clear break after the second component. Using Catell's scree test,²²⁴ it was decided to retain two components for further investigation. (Figure 4.4.3.3)

Figure 4.4.3.3 Graph of scree plot



Parallel analysis can also be used to estimate the number of components.²²⁵ The size of the eigenvalues obtained from Principal Component Analysis was compared with those obtained by a randomly generated data set of the same size. Only factors with eigenvalues exceeding the values obtained from the corresponding random data set were retained for further investigation. Parallel analysis was conducted using the software developed by Watkins in 2000.²²⁶ The use of two components was not further supported by the results of parallel analysis, which showed only one component with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the same size (11 items and 181 respondents). (Table 4.4.3.3b)

Table 4.4.3.3b Parallel analysis

Component number	Actual eigenvalue from PCA	Criterion from analysis	value parallel	Decision
1	3.984	1.4148		Accept
2	1.104	1.2862		Reject
3	1.027	1.2024		Reject
4	0.960	1.1254		Reject

However, the two-component solution explained a total of 50.876% of the variance, with Component 1 contributing 30.836% and Component 2 explaining 11.04%. Therefore, a factor analysis with 2 factors was forced. The strength of the relationship between the two factors was 0.466. In order to aid in the interpretation of these two components, Oblimin rotation was performed. Following Oblimin rotation, the two factors showed a moderate inter-correlation ($r=0.51$). Inspection of the pattern matrix showed a relatively clear two-factor solution.

Analysis of the structure matrix indicated good discrimination between the factors. For the module component, the lowest factor loading for module items was 0.341 for item 2, which was still higher than the highest loading on the module factor of a learning item (except question 12). The learning component also showed good discrimination. The lowest loading for learning items, -0.5 for item 5, was still higher than the highest loading item on the learning factor of a module item. (Table 4.4.3.3c)

Table 4.4.3.3c Factor analysis

Item	Pattern Coefficients		Structure Coefficients		Communalities
	Module	Learning	Module	Learning	
3	.792	.27	.778	-.378	.606
4	.746	.036	.727	-.345	.530
5	.604	-.191	.702	-.500	.520
6	.586	-.060	.637	-.405	.382
8	.581	-.108	.616	-.359	.414
2	.341	.055	.314	-.120	.101
7	-.013	-.786	.507	-.827	.608
11	.018	-.783	.418	-.792	.627
10	-.089	-.779	.389	-.780	.545
12	.113	-.769	.310	-.734	.694
1	.289	-.413	.500	-.561	.376

Overall, these results support the bi-dimensionality of the Virtual Patient questionnaire. In addition, the content of the factors obtained support the original scale structure proposed.

4.4.4 Questionnaire descriptive statistics

4.4.4.1 Mean scores for questionnaire

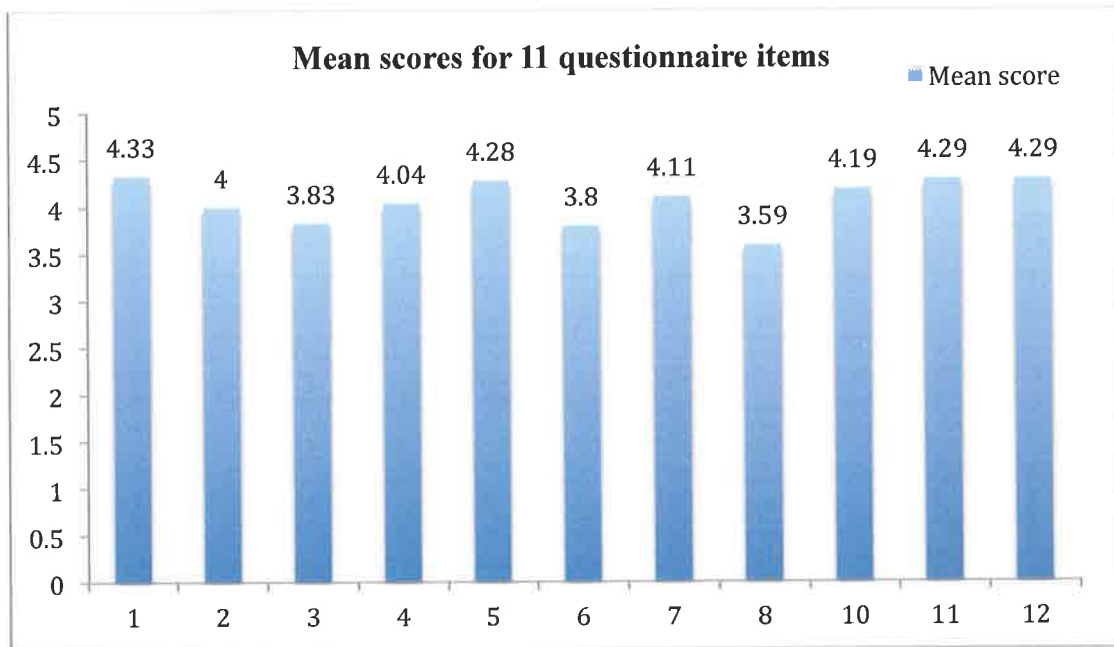
The mean score for the 11 items varied between 4.29 (SD= 0.68912, scale 1-5) and 3.59 (SD=0.93667, scale 1-5). The highest ranked statement was related to learning: 'Upon completion of the module, I am more aware of the difficulties surrounding the diagnosis and management of child abuse'. The lowest scoring item was: 'Working through the module was a valuable use of my time'.

The overall mean score for the questionnaire was 45 out of 55, with a median score of 45. Using the five point likert scale, the minimum score could be 11 (1 x 11) and the maximum score could be 55 (5 x 11). The midpoint on a 5-point scale is 3, so the midpoint score, marking the difference between a positive and negative evaluation of the Virtual Patient module would be 33 (3 x 11). The overall score lies above the midpoint at 45, with a standard deviation of 5.35. Therefore, the overall score was 2 standard deviations above the midpoint score. (Table 4.4.4.1 and Figure 4.4.4.1)

Table 4.4.4.1 Mean scores and standard deviation for 11 questionnaire items

Number	Questionnaire item	Mean	SD
1	The learning goals for the module were clearly stated	4.33	0.71
2	The module did not reflect real life situations	4	0.93
3	I would like to see similar modules throughout the course	3.83	0.97
4	The module was sufficiently interactive	4.04	0.79
5	The expert comments provided useful additional information	4.28	0.65
6	The learning activities (Reflection boxes, quizzes etc.) were well integrated into the module	3.8	0.86
7	The module helped me to reflect on professional issues	4.11	0.83
8	Working through the module was a valuable use of my time	3.59	0.94
10	The module helped me identify deficits in my knowledge	4.19	0.74
11	Upon completion of the module, I am more aware of the difficulties surrounding the diagnosis and management of child abuse	4.29	0.69
12	Upon completion of the case, I am more aware of the professional role with doctors have in the diagnosis and management of cases of suspected child abuse	4.29	0.7

Figure 4.4.4.1 Graph of mean scores for 11 questionnaire items



4.4.4.2 Mean scores for two factors

The table below gives the mean score and standard deviation for the two factors. The mean score for Factor 1 “Impact on learning” consisting of items 10,11,12,7,1 was 4.24 (scale 1-5), with a standard deviation of 0.55. The mean score for Factor 2 “Module content and delivery” consisting of items 2,3,4,5,6,8 was 3.92, with a standard deviation of 0.545. (Table 4.4.4.2)

Table 4.4.4.2 Mean score, standard deviation and confidence intervals for two factors

Factor	1	2
Mean	4.24	3.92
Standard Deviation	0.55	0.55
Confidence interval	4.16-4.32	3.84-4

4.4.4.3 Difference in overall questionnaire score between male and female students

A Mann-Whitney U Test revealed no statistical difference in overall mean questionnaire scores for the Virtual Patient between male (Md 89.1, n=90) and female (Md 92.9, n=90) students, U=3925, z=-0.484, p=0.63, r=0.03.

4.4.4.4 Difference in questionnaire scores between students who had seen cases of suspected abuse and students who had not

A Mann-Whitney U Test revealed no statistically significant difference in overall mean questionnaire score between students who had seen cases of suspected child abuse during their paediatric rotation (Md 87, n=39) and those who had not (Md 92.1, 142), U=2613, z=-0.54, p=0.589, r=0.04. When responses to individual statements were analysed, a Mann-Whitney U Test revealed a statistically significant difference in response to statement 8 ‘Working through the module was a valuable use of my time’, between students who had seen cases of child abuse and those that had not. Students who reported seeing cases of suspected child abuse during the course of their clinical attachment found the module to be less beneficial than students who had not. (Table 4.4.4.4)

Table 4.4.4.4 Difference in response to individual questionnaire items between students who had seen cases of suspected child abuse and students who had not

	1	2	3	4	5	6
Mann-Whitney U	2715.50	2700.00	2602.00	2410.00	2730.00	2575.50
Wilcoxon W	3495.50	3480.00	3382.00	3190.00	3510.00	12728.50
Z	-0.21	-0.26	-0.62	-1.49	-0.16	-0.74
Asymp. Sig. (2-tailed)	0.84	.079	.054	.015	0.88	0.46
	7	8	9	10	11	12
Mann-Whitney U	2570.50	2089.50	2655.00	2622.00	2659.00	2647.00
Wilcoxon W	12723.50	2869.50	12808.00	3402.00	3439.00	3427.00
Z	-0.78	-2.56	-0.49	-0.59	-0.44	-0.48
Asymp. Sig. (2-tailed)	0.43	0.01	0.62	0.56	0.66	0.63

4.4.5 Trainee evaluation of the Virtual Patient module used to facilitate a case based discussion

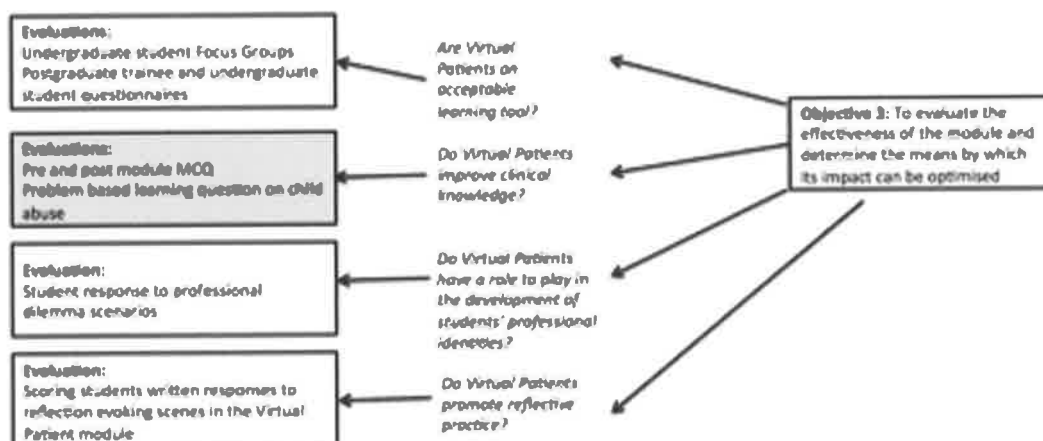
All 25 participants who attended the Basic Specialist Trainee Study day and participated in the case discussion completed the questionnaire. All participants agreed or strongly agreed that the case was enjoyable, interactive and appropriate for their level of training and a valuable use of their time. All agreed that they would like to see similar cases throughout their training and felt that group discussion promoted more learning than working on the case individually. Upon completion of the case, 23/25 (92%) participants reported greater self-confidence in their ability to recognize cases of suspected child abuse and 24/25 (96%) reported greater self-confidence in their ability to report cases of suspected child abuse. All felt that the Virtual Patient helped raise their awareness of the difficulties surrounding the diagnosis and management of child abuse and enabled them to identify deficits in their knowledge.

4.5 Research sub-question 2.2: Clinical knowledge gain

Do Virtual Patient improve clinical knowledge?

4.5.1 Point in study flow sheet (Figure 4.5.1)

Figure 4.5.1 Point in study flow sheet: Research question 2.2



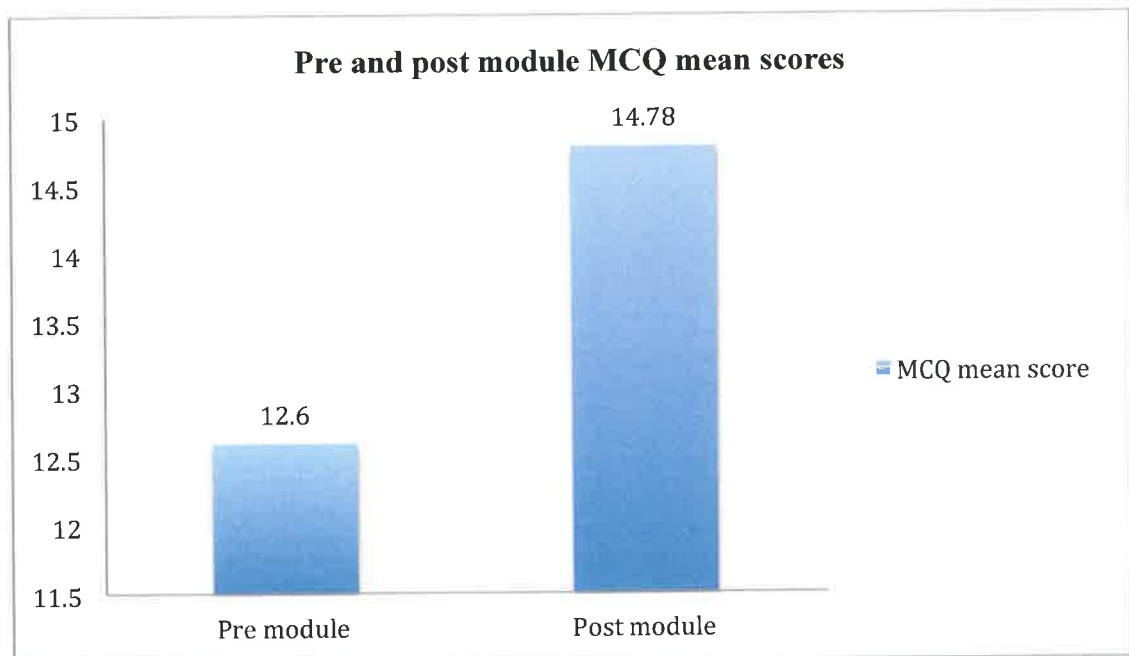
4.5.2 Pre and post module MCQ scores

The mean pre-module MCQ score was 12.6 (standard deviation 2.73). The minimum score was 6, with a maximum score of 18. The mean post-module MCQ score was 14.78 (Standard deviation 2.77). The minimum score was 7, with a maximum score of 22. As the distribution was not normally distributed, non-parametric tests were used to analyse the results. The Wilcoxon Signed Rank Test revealed a statistically significant increase in MCQ scores following completion of the module, $z=-8.564$, $p<0.0001$, with a large effect size of 0.45. The median score increased from 59% to 68%. (Table 4.5.2 and figure 4.5.2)

Table 4.5.2 Pre and post module MCQ mean scores and means

MCQ	Mean score	Standard deviation	P value
Pre module	12.6	2.73	<0.001
Post module	14.78	2.77	

Figure 4.5.2 Graph of pre and post module MCQ mean scores



4.5.3 Impact of academic performance on pre and post module MCQ scores

Mean marks for the End of Course examination were categorized as low or high (binarised on median mark) to enable presentation of the data. A Mann-Whitney U test revealed no statistically significant difference in pre and post test scores of academically high (Md=2.24, n=88) and academically low performing students (Md=2.75, n=88) $U=3811$, $z=-0.182$, $p=0.856$, $r=0.01$.

4.5.4 Impact of instructional method use on MCQ scores

For information that was presented directly in the Virtual Patient module, i.e. in text format, the maximum obtainable MCQ score was 8. The mean pre-module MCQ score for information that was presented directly in the module was 5.2, with a standard deviation of 1.54. The mean post-module MCQ score for information, which was presented directly in the module, was 5.9, with a standard deviation of 1.44.

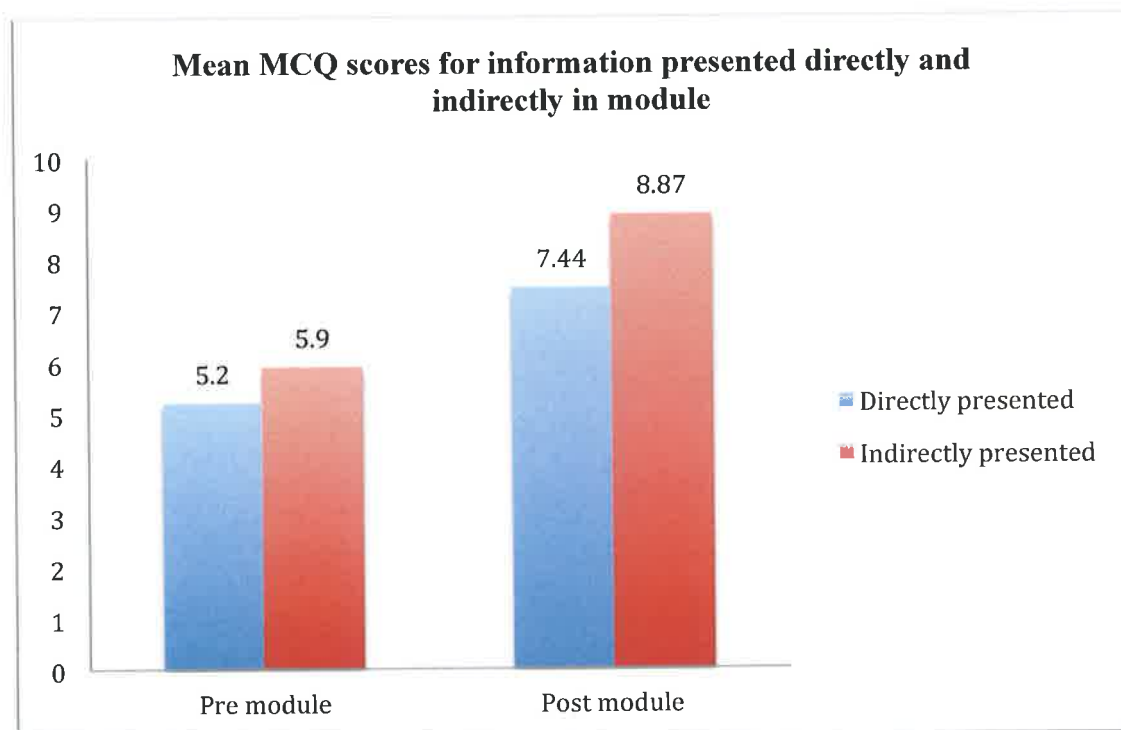
For information that was presented indirectly in the module i.e. through auditory or visual means, the maximum obtainable score was 14. The mean pre-module MCQ score for information that was presented indirectly in the module was 7.44, with a standard deviation of 2.05. The mean post-module MCQ score for information, which was presented indirectly in the module, was 8.87, with a standard deviation of 2.08.

A Wilcoxon Signed Rank Test revealed a statistically significant increase in MCQ scores following completion of the module for information that was presented directly ($z=-5.446$, $p<0.0001$), with a moderate effect size 0.4. The median score increased from pre-module (Md=5) to post-module (Md=6). A Wilcoxon Signed Rank Test revealed a statistically significant increase in MCQ scores following completion of the module for information that was presented indirectly ($z=-8.074$, $p<0.0001$), with a larger effect size of 0.6, than information that was presented directly. The median score increased from pre-module (Md=7) to post-module (Md=9). (Table 4.5.4 and figure 4.5.4)

Table 4.5.4 Pre and post module mean MCQ scores for information presented both directly and indirectly

Presentation of information	Pre module mean (SD)	Post module mean (SD)	P value
Direct	5.2 (1.54)	5.9 (1.44)	<0.0001
Indirect	7.44 (2.05)	8.87 (2.08)	<0.001

Figure 4.5.4 Graph of pre and post module mean MCQ scores for information presented both directly and indirectly



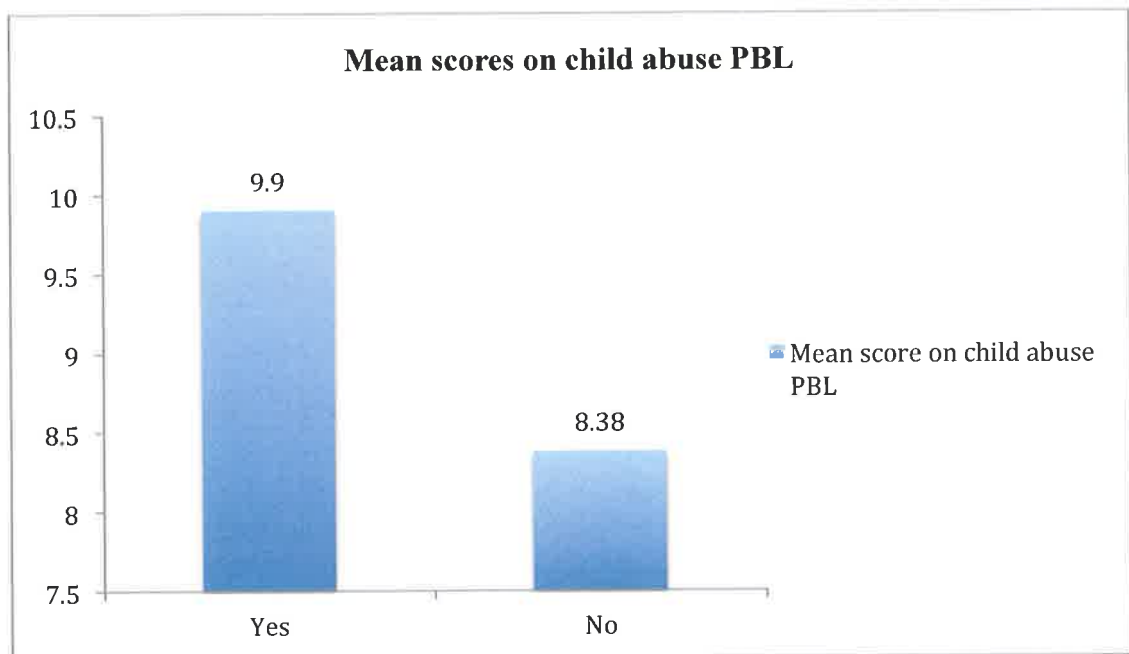
4.5.5 Difference in scores for the child abuse PBL between students who had completed the Virtual Patient module and those who chose not to complete the module

For the entire cohort of students (n=222), the mean score on the child abuse PBL in the End of Year examination was 9.59, with a standard deviation of 2.06. A Mann Whitney U test revealed a statistically significant difference in the score for the child abuse PBL between students who had completed the Virtual Patient module (Md=10, n=176) and those who had not (Md=8.5, n=46), U=2465, z= -4.095, p=0.0001, r= 0.3.). Using Cohen's criteria (1988), the effect size was moderate. (Table 4.5.5 and figure 4.5.5)

Table 4.5.5 Difference in mean scores on child abuse PBL between students that had completed the Virtual Patient module and those who had not

Completed Virtual Patient	Mean score on child abuse PBL	Standard deviation	P value
Yes	9.9	1.89	0.0001
No	8.38	2.23	

Figure 4.5.5 Graph of difference in mean scores on child abuse PBL between students that had completed the Virtual Patient module and those who had not



4.5.6 Difference in scores for the remaining seven PBL questions between students that had completed the Virtual Patient and those who chose not to complete the module

For the remaining 7 questions in the End of Year written examination, a Mann-Whitney U test revealed no statistically significant difference in scores between students who had completed the Virtual Patient module and those who chose not to participate, apart from question 5. For question 5, which dealt with the investigation and management of a child with a limp, there was statistically significant difference between students who had completed the Virtual Patient module (Md =9, n=176) and those who did not complete the module (Md=8, n=46), U=3162, z = -2.301, p = 0.021). However, the effect size was small at just 0.15. (Table 4.5.6)

Table 4.5.6 Difference in remaining End of Year PBL question scores between students who had completed the Virtual Patient module and those who chose not to complete the module

Virtual Patient	Mean	Std. Deviation	Median
Did not complete module	8.04	2.34	8.00
Completed module	8.96	2.37	9.00
Total	8.77	2.39	9.00

Virtual Patient	N	Mean Rank	Sum of Ranks
Q1 Did not complete module	46	114.82	5281.50
Q1 Completed module	176	110.63	19471.50
Q1 Total	222		
Q2 Did not complete module	46	103.77	4773.50
Q2 Completed module	176	113.52	19979.50
Q2 Total	222		
Q4 Did not complete module	46	105.98	4875.00
Q4 Completed module	176	112.94	19878.00
Q4 Total	222		
Q5 Did not complete module	46	92.24	4243.00
Q5 Completed module	176	116.53	20510.00
Q5 Total	222		
Q6 Did not complete module	46	108.42	4987.50
Q6 Completed module	176	112.30	19765.50
Q6 Total	222		
Q7 Did not complete module	46	106.39	4894.00
Q7 Completed module	176	112.84	19859.00
Q7 Total	222		
Q8 Did not complete module	46	113.21	5207.50
Q8 Completed module	176	111.05	19545.50
Q8 Total	222		

	Q1	Q2	Q4	Q5	Q6	Q7	Q8
Mann-Whitney U	3895.5	3692.5	3794.0	3162.0	3906.5	3813.0	3969.5
Wilcoxon W	19471.5	4773.5	4875.0	4243.0	4987.5	4894.0	19545.5
Z	-0.394	-0.917	-0.663	-2.302	-0.366	-0.608	-0.203
Asymp. Sig. (2-tailed)	0.693	0.359	0.507	0.021	0.714	0.543	0.839

4.5.7 Impact of instructional method used on child abuse PBL scores

An independent sample T-test was conducted to compare scores for the 4 parts of the Child Abuse PBL among students who had completed the Virtual Patient module and students who had not. Parts 1 and 2 dealt with content covered directly in the module i.e. in text format. Parts 3 and 4 dealt with content covered indirectly in the module i.e. through auditory or visual means.

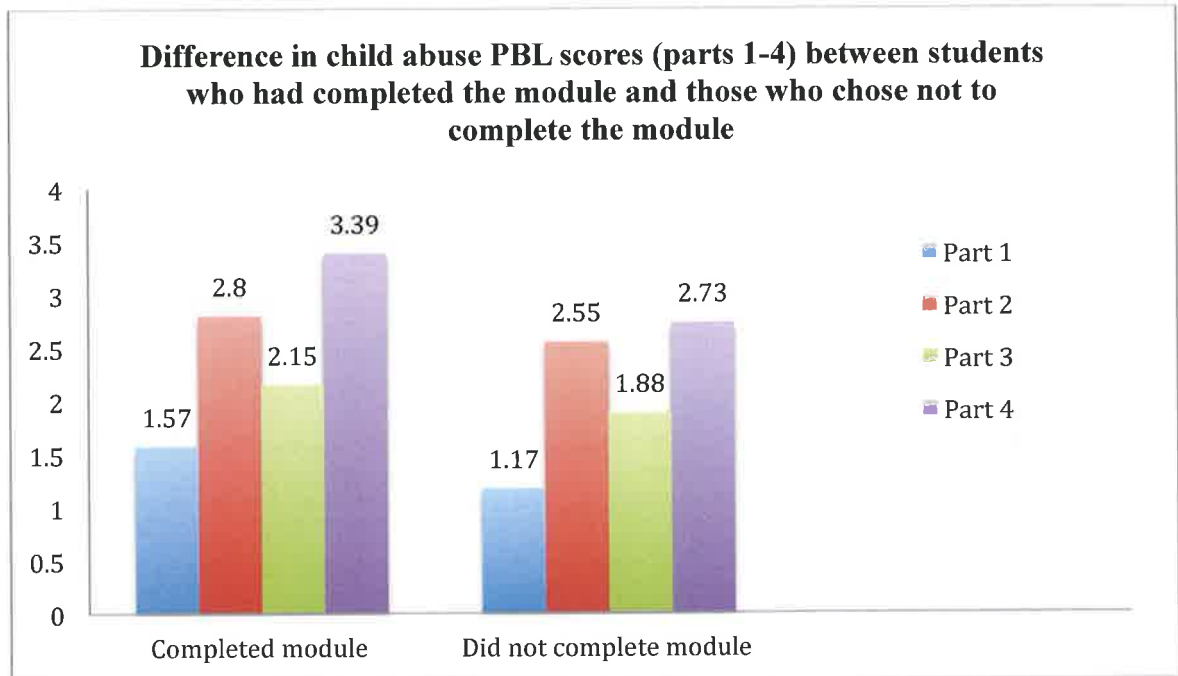
For part 1, there was a statistically significant difference in scores for students who completed the Virtual Patient module (M 1.57, SD 0.79) and students who had chosen not to participate ((M 1.17, SD 0.71); $t(224) = 3.05$, $p = 0.003$ two tailed). The magnitude of the difference in the means (mean difference = 0.39, 95% CI 0.14-0.65) was small to moderate (eta squared = 0.04).

For part 2, there was a statistically significant difference in scores for students who completed the Virtual Patient module (M 2.80, SD 0.39) and students who chose not to participate ((M 2.55, SD 0.67); $t(224) = 2.43$, $p = 0.019$ two tailed). The magnitude of the difference in the means (mean difference = 0.25, 95% CI 0.04 to 0.46) was small (eta squared = 0.03).

For part 3, there was a statistically significant difference in scores for students who completed the Virtual Patient module (M 2.15, SD 0.71) and students who chose not to participate ((M 1.88, SD 0.75); $t(224) = 2.268$, $p = 0.024$ two tailed). The magnitude of the difference in the means (mean difference = 0.27, 95% CI 0.04 to 0.50) was small (eta squared = 0.02).

For part 4, there was a statistically significant difference in scores for students who completed the Virtual Patient module (M 3.39, SD 0.74) and students who chose not to participate ((M 2.73, SD 0.16); $t(224) = 3.996$, $p = 0.0001$ two tailed). The magnitude of the difference in the means (mean difference = 0.66, 95% CI 0.34 to 0.99) was moderate (eta squared = 0.07). (Figure 4.5.7)

Figure 4.5.7 Graph of difference in child abuse PBL scores (parts 1-4) between students who had completed the Virtual Patient module and those who chose not to complete the module



4.5.8 Impact of student grouping on child abuse PBL scores

For students who had completed the Virtual Patient module, a Kruskal-Wallis test revealed no statistically significant difference in scores on the child abuse PBL across the four different student groups. (Group 1, n=38, Group 2 n=47, Group 3, n=48, Group 4, n=43) $X^2(n=176) = 7.429, p=0.059$. The highest scoring group was group 2 (Md= 10.5) and the lowest scoring group was group 4 (Md=9). (Table 4.5.8)

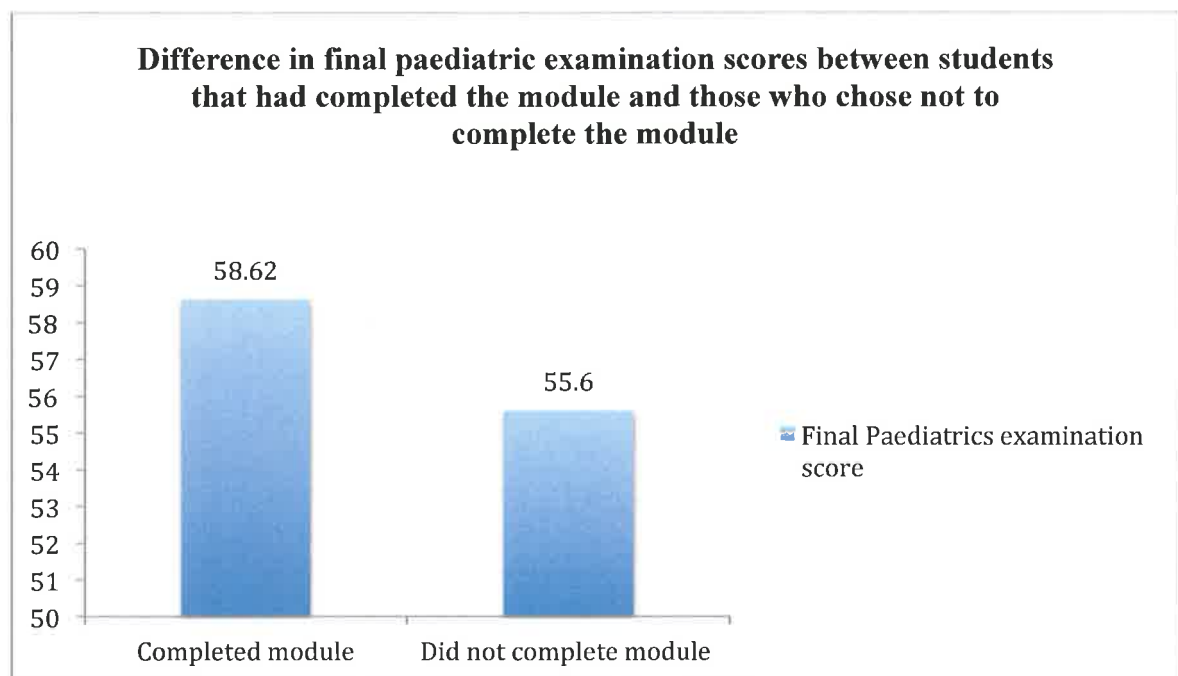
Table 4.5.8 Difference in child abuse PBL scores between four student groups

Student groups	Mean	Standard deviation	P-value
1	9.53	2.08	0.059
2	10.41	1.8	
3	10.05	1.66	
4	9.5	1.96	

4.5.9 Impact of academic performance on participation in Virtual Patient module

The mean mark for the End of Year final examination was 57.99, with a standard deviation of 7.79. The marks results were normally distributed. There was a significant difference in scores for students who completed the module (M=58.62, SD 7.84) and students who chose not to participate ((M=55.6, SD 7.17; $t(222) = 2.37$, $p = 0.019$ two tailed independent). However, based on the guidelines proposed by Cohen (1988), the magnitude of the difference in the means (mean difference = 3.02, 95% CI 0.51 to 5.54 was small ($\eta^2 = 0.025$). (Figure 4.5.9)

Figure 4.5.9 Graph of difference in final paediatrics examination scores between students that had completed the module and those who chose not to complete the module



Hierarchical multiple regression was used to determine whether completion of the Virtual Patient module predicted scores on the child abuse PBL, after controlling for academic strength (based on final paediatric examination mark). Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity.

Final paediatric examination results were entered at step 1, explaining 33.5% of the variance in question 3 scores. After entry of “completion of the Virtual Patient module” at step 2, the total variance explained by the module was 38% ($F(222) = 67.05, p = 0.0001$). Completion of the Virtual Patient module explained an additional 4.5% of the variance in scores for question 3, after controlling for academic strength ($R^2 \text{ change} = 0.045, F = 15.806, p = 0.001$). In the final model, both academic strength and completion of the Virtual Patient module were statistically significant, with EOY results showing a higher beta value ($\beta = 0.545, p < 0.001$) than completion of the Virtual Patient module ($\beta = 0.214, p < 0.001$). (Tables 4.5.9a 4.5.9b)

Table 4.5.9a Descriptive statistics and correlations

Variables	Child abuse PBL	Academic strength	Completion of module
Child abuse PBL	1		
Academic strength	0.579*	1	
Completion of module	0.3*	0.158*	1
Means	9.56	58	0.79
Standard Deviations	2.06	7.9	0.41

Statistical significance * $p < 0.0001$

Table 4.5.9b Hierarchical Regression model

	R	R ²	R ² Change	B	SE	Beta	T
Step 1	0.58	0.33*	0.335*				
Academic strength				0.15	0.02	0.58*	10.53
Step 2	0.62	0.37*	0.045*				
Academic strength				0.15	0.14	0.55*	10.11
Completion of module				1.09	0.27	0.21*	3.98

Statistical significance * $p < 0.0001$

R² = amount of variance explained by independent variable

R² change = additional variance in dependent variable

B = unstandardized coefficient

Beta = Standardized coefficient (values for each variable are converted to the same scale so they can be compared)

SE = standard error

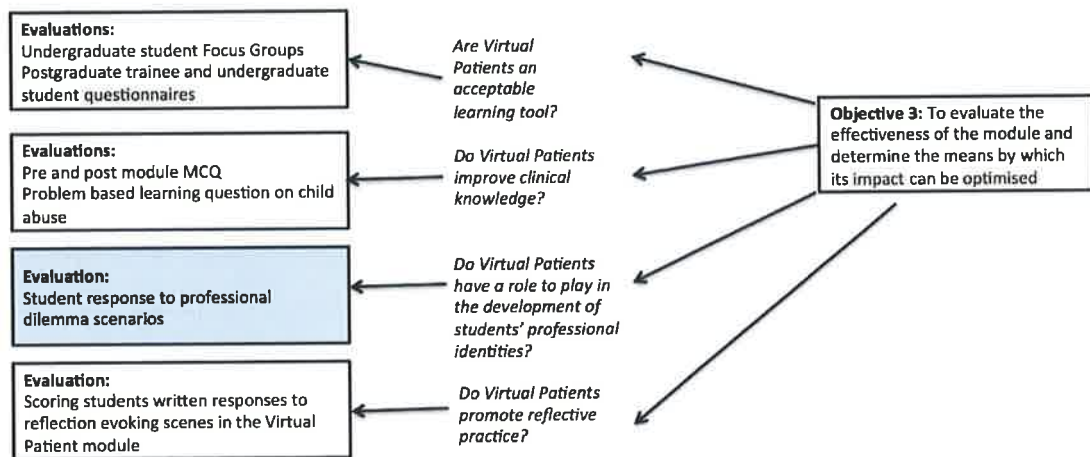
T = estimated coefficient (B) divided by its own SE. If $t < 2$ the independent variable does not belong to the model

4.6 Research sub-question 2.3: Professional identity

Do Virtual Patients have a role to play in the development of students' professional identities?

4.6.1 Point in study flow sheet (Figure 4.6.1)

Figure 4.6.1 Point in study flow sheet: Research question 2.3



4.6.2 Postgraduate trainee response to professional dilemma scenarios

20 paediatric trainees attending a Basic Specialist Training study day were invited to complete the online Virtual Patient module. For Professional Dilemma scenario 1, all but 1 trainee chose answer 3 as their ideal answer on their first attempt. For the remaining 2 Professional Dilemmas, all SHOs chose the ideal answer on their first attempt. (Table 4.6.2)

Table 4.6.2 Postgraduate trainee response to Professional Dilemma scenarios

Post-graduate Trainees	1st attempt	%	2nd attempt	%	3rd attempt	%	4th attempt	%
Professional Dilemma 1	19	95	1	5	0	0	0	0
Professional Dilemma 2	20	100	0	0	0	0	n/a	n/a
Professional Dilemma 3	20	100	0	0	0	0	0	0

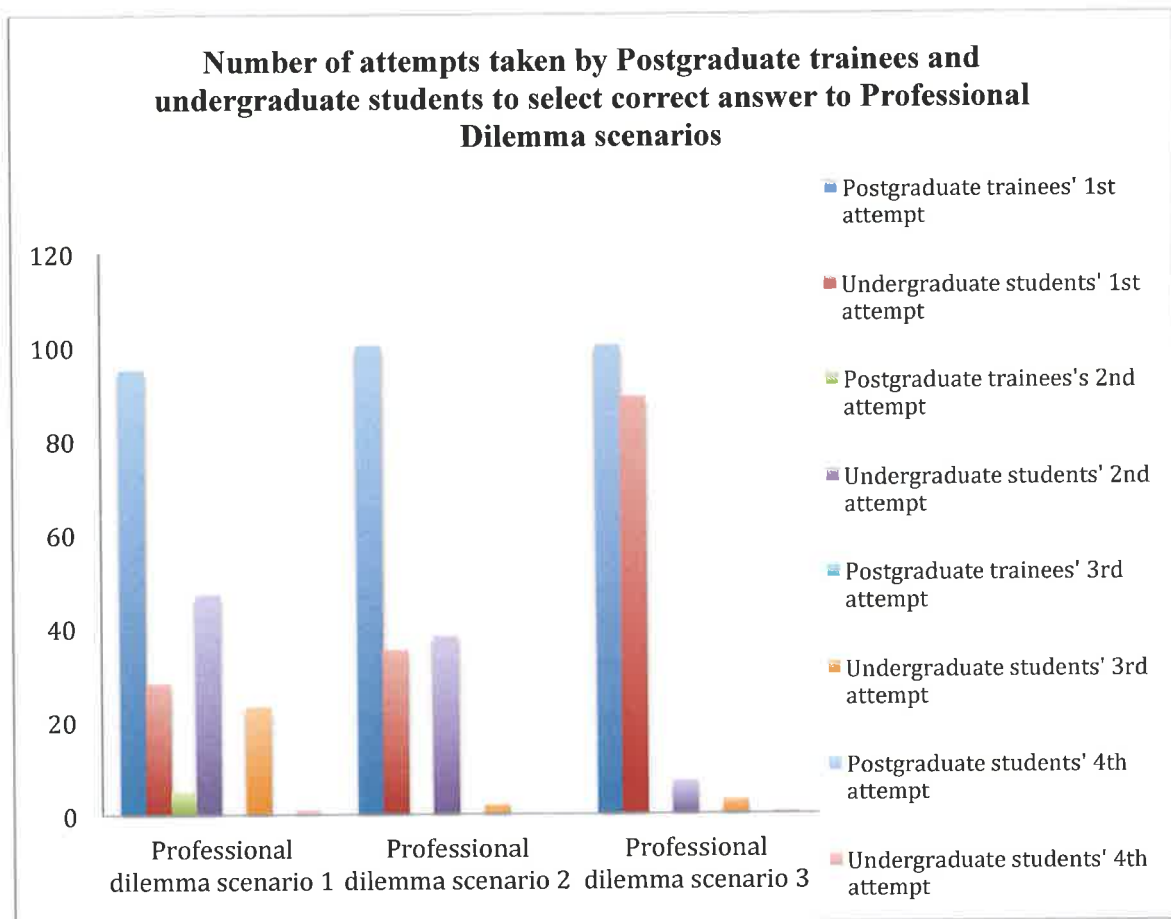
4.6.3 Undergraduate trainee response to professional dilemma scenarios

181 paediatric students completed the online Virtual Patient module (response rate 81%). Over the course of the module, the number of students who selected the correct answer on the first attempt improved, while the number of students who required second, third and fourth attempts to select the correct answer decreased. (Table and figure 4.6.3)

Table 4.6.3 Undergraduate student response to Professional Dilemma scenarios

Under-graduate Students	1st attempt	%	2nd attempt	%	3rd attempt	%	4th attempt	%
Professional Dilemma 1	51	28	85	47	42	23	2	1
Professional Dilemma 2	64	35	69	38	4	2	n/a	n/a
Professional Dilemma 3	161	89	13	7	5	3	1	0.5

Figure 4.6.3 Graph of number of attempts taken by Postgraduate trainees and undergraduate students to select correct answer to Professional Dilemma scenarios



4.6.4 Number of attempts taken to select ideal answer to professional dilemma scenarios

The results of the Friedman Test indicated that there was a statistically significant reduction in the number of attempts taken to select the ideal answer for the Professional Dilemma scenarios during the module (χ^2 (N=181)= 126, $p < 0.001$). Inspection of the median showed a decrease in the number of attempts from 2 in scenario 1 to 1 in scenarios 2 and 3. (Table 4.6.4)

Table 4.6.4 Number of attempts taken to select ideal answer to Professional Dilemma scenarios

	N	Percentiles		
		25th	50th (Median)	75th
Number of attempts for Professional Dilemma 1	181	1.00	2.00	2.00
Number of attempts for Professional Dilemma 2	181	1.00	1.00	2.00
Number of attempts for Professional Dilemma 3	181	1.00	1.0000	1.00

	Mean Rank
Number of attempts for Professional Dilemma 1	2.52
Number of attempts for Professional Dilemma 2	1.92
Number of attempts for Professional Dilemma 3	1.57

N	181
Chi-square	125.556
df	2
Asymp. Sig.	.000

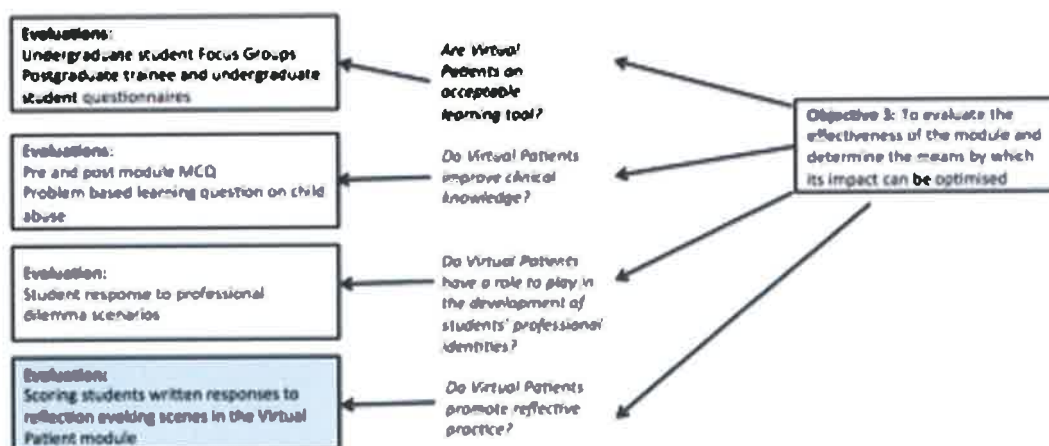
a. Friedman Test

4.7 Research sub-question 2.4: Reflective Practice

Do Virtual Patients promote reflective practice?

4.7.1 Point in study flow sheet (Figure 4.7.1)

Figure 4.7.1 Point in study flow sheet: Research question 2.4



4.7.2 Number of reflectors and non reflectors for each reflection scene

Students who did not document any reflections are referred to as ‘Non Reflectors’. Students who document at least one reflection are referred to as ‘Reflectors’. Of the 181 students who completed the entire Virtual Patient module, 119 responded to all 5 reflection scenes (response rate 66%), with 13% of students not documenting reflections on any scenes (n=24). The mean number of reflections documented was 3.97. The scene with the highest response was scene 1, with 84% of students documenting reflections. (Figure 4.7.2 and table 4.7.2)

Figure 4.7.2 Graph of number of reflections documented

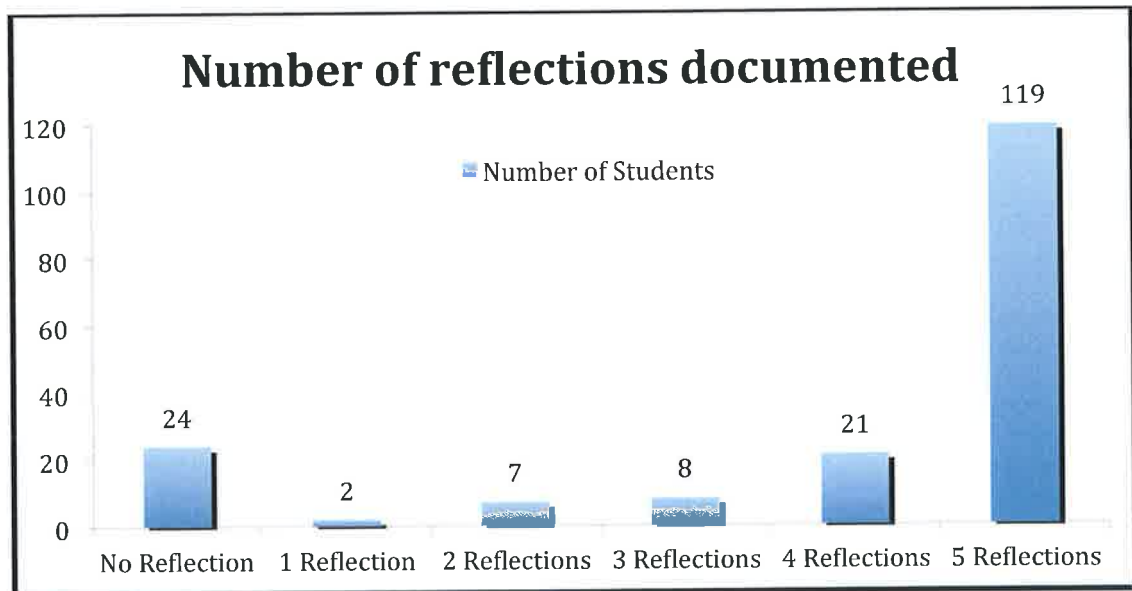


Table 4.7.2 Number of reflectors and non reflectors for each reflection scene

Reflection scenes	Reflector	Non reflector
Scene 1	84 %	16%
Scene 2	78%	22%
Scene 3	81%	19%
Scene 4	79%	21%
Scene 5	70%	30%

4.7.3 Correlation between raters for five reflection scenes

For all five scenes there was a strong correlation between the overall scores given to each student by the two raters. The highest correlation was for scene 5. (Table 4.7.3)

Table 4.7.3 Correlation between raters for all reflection scenes

Reflection scenes	Correlation
Scene 1	0.835
Scene 2	0.826
Scene 3	0.83
Scene 4	0.872
Scene 5	0.91

4.7.4 Difference in overall reflection scores between groups

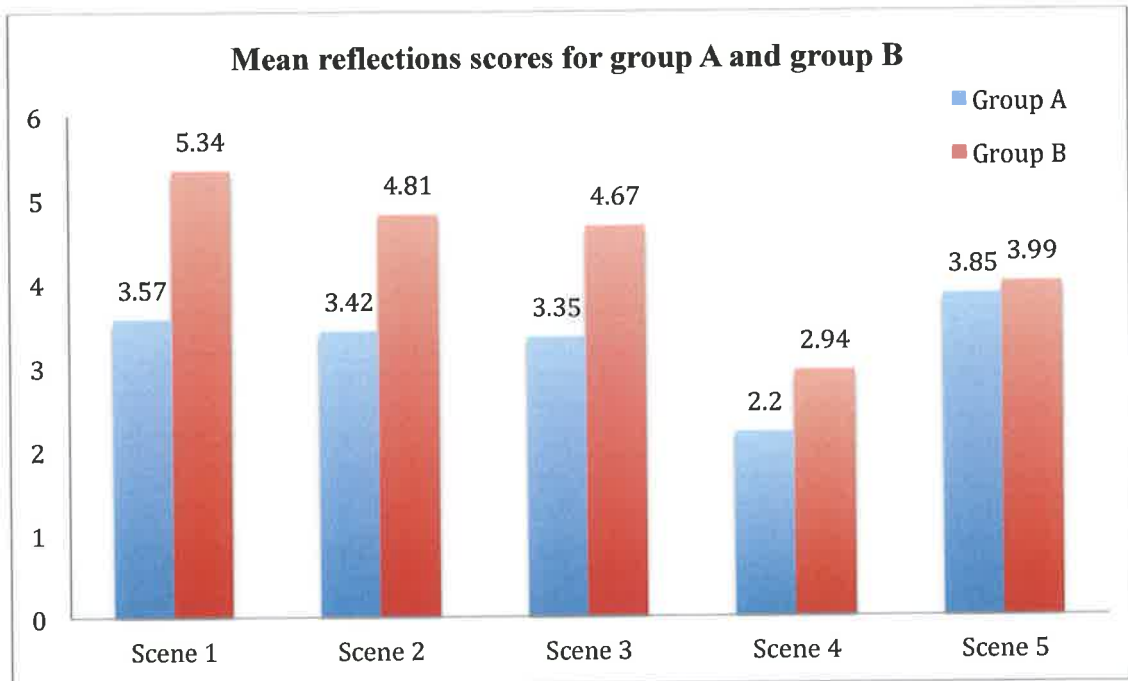
Overall reflection scores ranged from a minimum of 1 to a maximum of 10. The highest scoring scene was scene 1, with a mean score of 4.45. The lowest scoring scene was scene 4, with a mean score of 2.56. When analysed by groups (A; who were prompted to reflect by the use of open ended questions only and B; who were provided with a framework to help structure their responses), Mann Whitney U tests revealed a statistically significant difference in overall reflection scores of students in group A and group B for all reflection scenes, except scene 5. (Table 4.7.4 and figure 4.7.4)

Table 4.7.4. Difference in overall reflection scores between group A and group B

	Mean score (Max 10)	Group A	Group B	P value
Scene 1	4.45 (SD 2.35)	3.57 (SD 2.03)	5.34 (SD 2.33)	0.001
Scene 2	4.11 (SD 2.12)	3.42 (SD 1.73)	4.81 (SD 2.25)	0.001
Scene 3	4 (SD 2.15)	3.35 (SD 1.8)	4.67 (SD 2.28)	0.0001
Scene 4	2.56 (SD 1.76)	2.2 (SD 1.5)	2.94 (SD 1.94)	0.009
Scene 5	3.92 (SD 2.19)	3.85 (SD 2.23)	3.99 (SD 2.17)	0.72

Figure 4.7.4

Graph of mean reflection scores for group A and group B



4.7.5

Difference in overall reflection scores for variables

Although female students scored consistently higher than male students on all reflection scenes, Mann Whitney U tests revealed statistically significant differences in scenes 3 and 4 only. Mean marks for the End of Course examination were categorized as low or high (binarised on median mark) to enable presentation of the data. There was no statistically significant difference in scores between low and high achieving students for any of the five reflection scenes. Data were available for 138 students regarding whether or not they had completed a degree prior to starting medical school (post-graduate students). Postgraduate students scored higher than students who had not completed a previous degree, for all reflection scenes. The difference reached statistical significance for reflection scenes 1, 2 and 4. (Table 4.7.5 and figures 4.7.5a, b and c)

Table 4.7.5 Difference in overall reflection scores for variables

	Male	Female	P value	Acad Low	Acad high	P value	Previous degree	No previous degree	P value
Scene 1	4.5 (SD 2.37)	5 (SD 2.3)	0.08	4.5 (SD 2.38)	4.5 (SD 2.31)	0.5	5.5 (SD 2.5)	4 (SD 2.3)	0.05
Scene 2	3.5 (SD 2.15)	4.5 (SD 2)	0.08	3.5 (SD 2.2)	4 (SD 1.97)	0.15	5 (SD 2.1)	3.75 (SD 2.07)	0.03
Scene 3	3.64 (SD 2.19)	4.35 (SD 2.05)	0.04	3.79 (SD 2.21)	4.16 (SD 2.07)	0.29	4.46 (SD 2.13)	3.85 (SD 2.15)	0.12
Scene 4	2.3 (SD 1.76)	2.8 (SD 1.74)	0.02	2.3 (SD 1.64)	2.81 (SD 1.88)	0.08	3.3 (SD 2)	2.22 (SD 1.49)	0.00
Scene 5	3.54 (SD 2)	4.25 (SD 2.27)	0.7	3.64 (SD 2)	4.17 (SD 2.28)	0.18	4.43 (SD 2.56)	3.78 (SD 2)	0.15

Figure 4.7.5a Graph of difference in overall reflection scores between male and female students

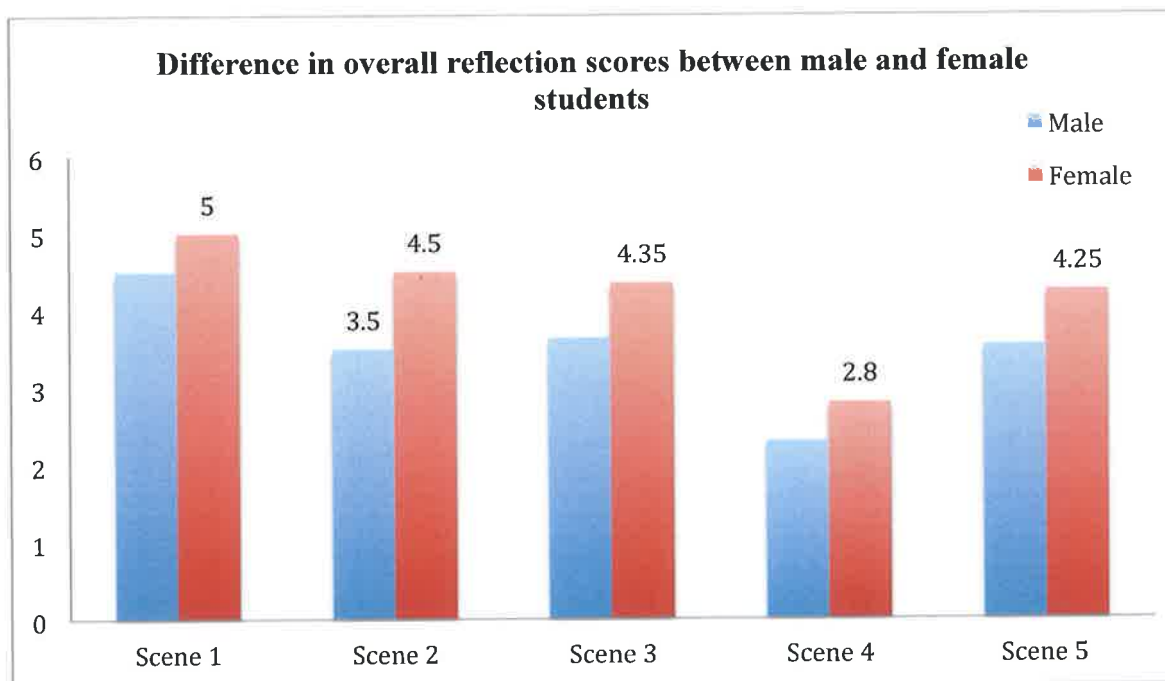


Figure 4.7.5b

Graph of difference in overall reflection scores between academically low and high achieving students

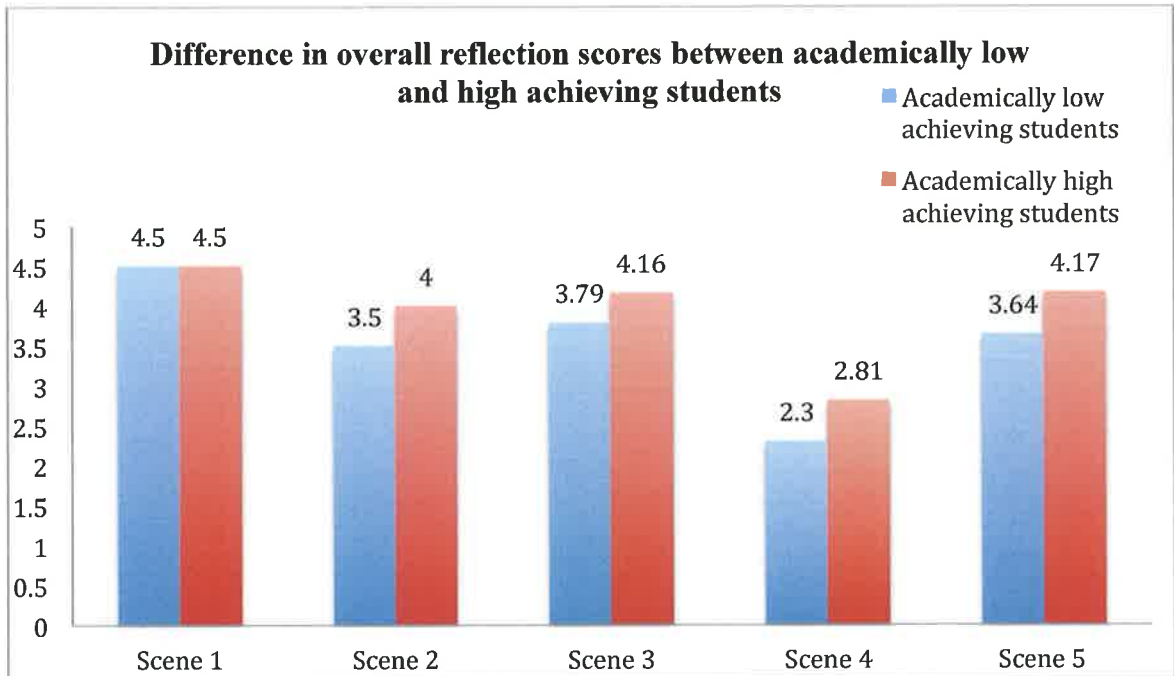
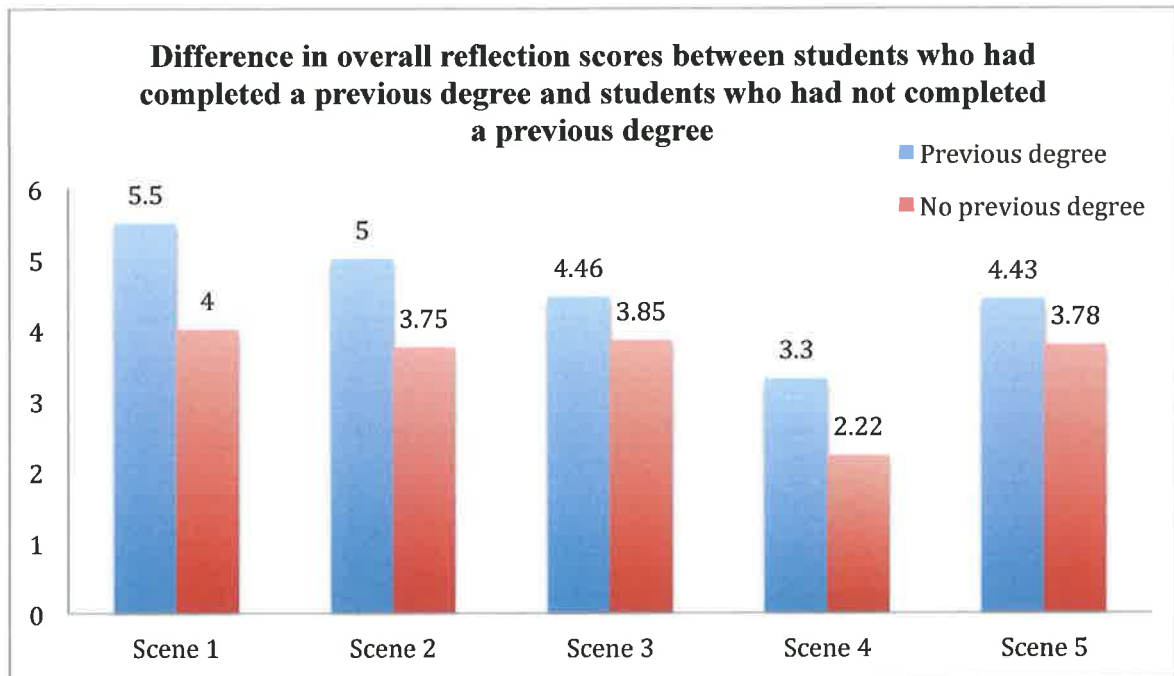


Figure 4.7.5c

Graph of difference in overall reflection scores between students who had completed a previous degree and students who had not completed a previous degree



4.7.6 Correlation between perspectives and overall reflection score

Scores on perspectives and the relationship of perspectives to overall reflection scores were analysed. The table below shows the percentage of students who mentioned perspectives either once or extensively for all five reflection scenes. Spearman correlation was used to determine the relationship of the perspective to the overall reflection score. (Table 5.6.6)

Table 4.7.6 Correlation between perspectives and overall reflection scores

Perspective	Scene 1	P-value	Scene 2	P-value	Scene 3	P-value	Scene 4	P-value	Scene 5	P-value
Doctor	0.72	0.00	0.16	0.05	0.70	0.00	0.67	0.00	0.68	0.00
Education	0.68	0.00	0.29	0.00	0.51	0.00	0.57	0.00	0.49	0.00
Ethical	0.72	0.00	0.72	0.00	0.53	0.00	0.64	0.00	0.50	0.00
Family	0.26	0.00	0.78	0.00	0.64	0.00	0.44	0.00	0.15	0.09
Health Professional	0.78	0.00	0.71	0.00	0.38	0.00	0.73	0.00	0.47	0.00
Hierarchy	0.56	0.00	0.21	0.01	0.47	0.00	0.64	0.01	0.27	0.00
Legal	0.50	0.00	0.71	0.00	0.65	0.00	0.61	0.00	0.48	0.00
Medical	0.57	0.00	0.69	0.00	0.70	0.00	0.64	0.00	0.47	0.00
Patient	0.74	0.00	0.72	0.00	0.43	0.00	0.64	0.00	0.52	0.00
Personal Feelings	-0.21	0.10	-0.11	0.20	-0.23	0.01	-0.12	0.17	0.20	0.00
Personal Opinion	0.35	0.00	0.14	0.08	0.28	0.00	0.53	0.00	0.49	0.00
Professionalism	0.78	0.00	0.83	0.00	0.70	0.00	0.79	0.00	0.74	0.00

4.7.7 Correlation between scores of five reflection scenes

The correlation between scores on the five reflective scenes was high for all cases and ranged from 0.505 to 0.725. The strongest correlation was for scenes 2 and 3, the weakest correlation was for scenes 1 and 5. (Table 4.7.7)

Table 4.7.7 Correlation between scores of five reflection scenes

		Reflection scene 1	Reflection scene 2	Reflection scene 3	Reflection scene 4	Reflection scene 5
Reflection scene 1	Pearson Correlation	1	.682	.567	.512	.505
	Sig. (2-tailed)		.000	.000	.000	.000
	N	155	148	140	137	123
Reflection scene 2	Pearson Correlation	.682	1	.725	.626	.582
	Sig. (2-tailed)	.000		.000	.000	.000
	N	148	152	143	138	124
Reflection scene 3	Pearson Correlation	.567	.725	1	.584	.574
	Sig. (2-tailed)	.000	.000		.000	.000
	N	140	143	146	138	125
Reflection scene 4	Pearson Correlation	.512	.626	.584	1	.572
	Sig. (2-tailed)	.000	.000	.000		.000
	N	137	138	138	142	122
Reflection scene 5	Pearson Correlation	.505	.582	.574	.572	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	123	124	125	122	127

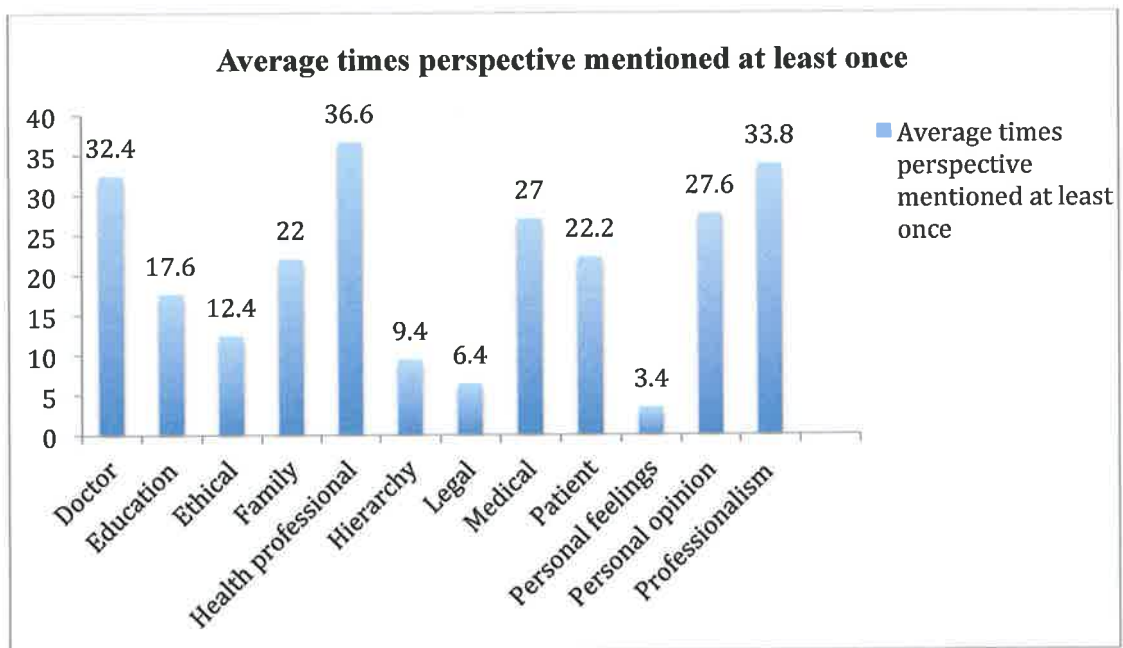
4.7.8 Number of times perspective mentioned at least once

For each reflection scene, there were twelve perspectives that were scored. The commonest perspective mentioned was that of the health professional. This was mentioned at least once, an average of 36.6 times. The second most common perspective mentioned was that of the doctor, mentioned at least once, an average of 32.4 times. (Table 4.7.8 and figure 4.7.8)

Table 4.7.8 Number of times perspective mentioned at least once

Perspective	Scene 1	Scene 2	Scene 3	Scene 4	Scene 5	Average
Doctor	23	3	52	25	59	32.4
Education	28	1	11	16	32	17.6
Ethical	13	21	10	5	13	12.4
Family	1	57	45	7	0	22
Health Professional	41	78	8	28	28	36.6
Hierarchy	19	2	12	10	4	9.4
Legal	10	25	17	15	15	16.4
Medical	24	50	33	18	10	27
Patient	19	35	18	11	28	22.2
Personal Feelings	0	0	11	0	6	3.4
Personal Opinion	14	11	55	8	50	27.6
Professionalism	22	56	38	26	27	33.8

Figure 4.7.8 Graph of average times perspectives mentioned at least once



4.7.9 Number of times perspective mentioned extensively

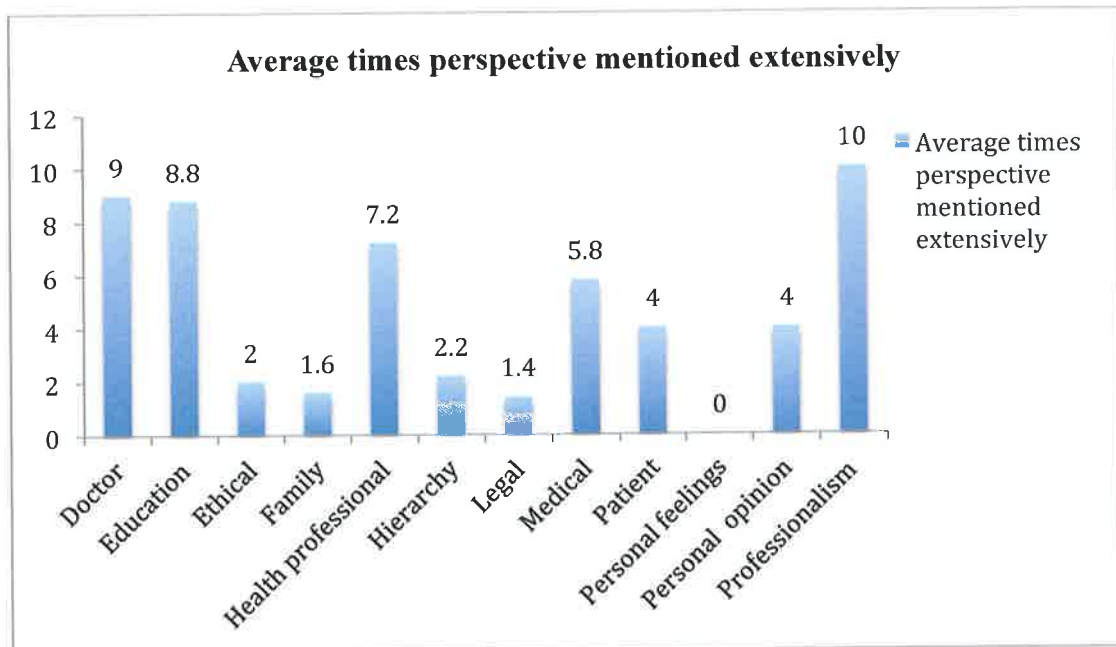
The most extensively mentioned perspective (mentioned more than once by an individual student in response to a single reflection scene) was professionalism.

Perspectives were mentioned extensively in scenes 1 and 5. (Table 4.7.9 and figure 4.7.9)

Table 4.7.9 Number of times perspectives mentioned extensively

Perspective	Scene 1	Scene 2	Scene 3	Scene 4	Scene 5	Average
Doctor	19	1	14	1	10	9
Education	14	1	2	3	24	8.8
Ethical	5	1	1	1	2	2
Family	1	1	6	0	0	1.6
Health Professional	25	2	2	3	4	7.2
Hierarchy	8	0	2	0	1	2.2
Legal	3	1	2	1	0	1.4
Medical	14	1	4	8	2	5.8
Patient	9	1	1	4	5	4
Personal Feelings	0	0	0	0	0	0
Personal Opinion	6	1	3	1	9	4
Professionalism	28	1	5	4	12	10

Figure 4.7.9 Graph of average times perspectives mentioned extensively



4.8 Summary

Results of research question 1:

224 student logbooks were reviewed, describing an average of 18.74 cases per student. The top five cases seen were gastroenteritis, bronchiolitis, asthma, viral upper respiratory tract infections and pneumonia, accounting for over 25% of the total cases seen. Of the 160 different diseases or presenting signs and symptoms seen, academic staff ranked 54 cases as essential. The average student exposure to these essential cases was 18.73%.

Results of research question 2

A total of 181 students completed the entire Virtual Patient module (Response rate 81%). The student focus groups found that students learn from engagement, interaction and participation in integrated modules that they recognise as relevant and reliable. The questionnaire developed to evaluate the module was shown to have acceptable psychometric properties. It assessed 2 factors, (1) 'impact on learning' and (2) 'module content and design'. The overall mean score for the questionnaire was 45 out of 55. The mean score for factors 1 and 2 were 4.24 and 3.92, respectively (scale 1-5). Postgraduate trainees agreed or strongly agreed that the case was enjoyable, interactive and appropriate for their level of training and a valuable use of their time. Over 90% of postgraduate participants reported greater self-confidence in their ability to recognize and report cases of suspected child abuse.

There was a statistically significant increase in MCQ scores following completion of the module. The median score increased from 59% to 68%. There was a statistically significant increase in MCQ scores for information that was presented both directly (in text format) and indirectly (auditory or visual means). However the effect size was larger for information that was presented indirectly. There was a statistically significant difference in the score for the child abuse PBL between students who had completed the Virtual Patient module and those who had not ($p=0.0001$). This difference was statistically significant for all 4 parts of the Child abuse PBL.

For Professional Dilemma scenario 1, all but 1 paediatric trainee chose the correct answer on their first attempt. For the remaining 2 Professional Dilemmas, all trainees

chose the ideal answer on their first attempt. Over the course of the module, there was a statistically significant reduction in the number of attempts taken by students to select the ideal answer for the Professional Dilemma scenarios ($p < 0.001$).

119 students responded to all 5 reflection scenes (response rate 66%). The mean number of reflections documented was 3.97. For all five scenes there was a strong correlation between the overall scores given to each student by the two raters. The highest scoring scene was scene 1, with a mean score of 4.45 (scale 1-10). There was a statistically significant difference in overall reflection scores of students in group A (promoted to reflect by the use of open ended questions only) and group B (provided with a framework to help structure their responses) for all reflection scenes, except scene 5.

Female students scored consistently higher than male students on all reflection scenes. There was no statistically significant difference in scores between low and high achieving students for any of the five reflection scenes. For all reflection scenes, postgraduate students scored higher than students who had not completed a previous degree.

Correlations between the different perspectives and overall reflection score were positive except for personal feelings. The correlation between scores on the five reflective scenes was high for all cases and ranged from 0.505 to 0.725. The commonest perspective mentioned at least once was that of the 'health professional', followed by 'doctor'. The most extensively mentioned perspective (mentioned more than once by an individual student in response to a single reflection scene) was professionalism.

Chapter 5

Discussion

5.1 Introduction

In order to continue to educate and train highly qualified doctors to meet the health care needs of the 21st century, medical education is constantly evolving and adapting. It is now generally accepted that we can no longer rely on the traditional apprenticeship model to support the delivery of undergraduate education. The practice of medicine and its scientific, pharmacological and technological foundations have been transformed and we are now embracing technology as a means to augment clinical teaching and learning.

Virtual Patient modules represent a heterogeneous group of e-learning tools. Although they have begun to enter the mainstream of medical education, the evidence base to guide their use is only beginning to be accumulated. To date, the majority of Virtual Patient modules have been focussed on the development of clinical reasoning skills. However, educators have a responsibility to ensure that we support not just the acquisition of clinical knowledge, but also the skills of self-directed, reflective, life-long learning. In parallel with this, students need support to develop their professional identities and become members of the profession.

The hypothesis of this thesis was that the use of Virtual Patients would not significantly improve the development of clinical knowledge, professional identity and reflective skills in undergraduate medical students. The research sought to answer two questions:

1. Based on an evaluation of current undergraduate training, is there a need to supplement the traditional undergraduate paediatric curriculum to ensure students receive equivalent educational experiences to one another?
2. Are Virtual Patients an effective learning tool to support undergraduate education?

The following section will discuss how the study findings answered the two research questions and disproved the null hypotheses, thereby supporting the role of Virtual Patients in improving the development of clinical knowledge, professional identity

and reflective skills in undergraduate medical students. It begins by discussing important findings from the analysis of student logbooks and considers how the limitations found in students clinical exposure can be overcome by supporting learning with e-learning resources, specifically Virtual Patients. Having determined the need to augment the traditional curriculum, the effectiveness of the study's online Video-based Virtual Patient is then reviewed. Kirkpatrick's Learning Evaluation Model is an established method to assess the impact of an educational intervention²²⁷. There are four levels to Kirkpatrick's model:

- Level 1: Reaction- the reaction of the learners to the learning experience
- Level 2: Learning- the resulting increase in knowledge and/or skill
- Level 3: Behaviour- the extent of behaviour or attitude change
- Level 4: Results- the effect on the environment

This model provides a useful framework for discussing the study's findings on the effectiveness of the Virtual Patient module. Firstly, the reactions of undergraduate students and postgraduate trainees to the module are discussed. Having demonstrated that learners value the module as an acceptable learning tool, the author then discusses the study findings which address level 2 of Kirkpatrick's model: the impact on learning. In order to demonstrate that participation in the module improved clinical knowledge, the results of the pre and post module MCQ and End of Year examination are considered. In addition, the impact of instructional design on knowledge gain is reviewed. Having examined the study findings that address level 1 and 2 of Kirkpatrick's model, the discussion then considers the extent to which the module evaluation addresses Level 3 of Kirkpatrick's model by gaining an understanding of whether learners' behaviour was influenced by teaching about professional norms and the value of reflective practice. The discussion concludes with an examination of the study's limitations and implications for future research and practice.

5.2 Current paediatric curriculum

5.2.1 Introduction

The diversity of student case-mix exposure in paediatrics is well documented in the literature.²²⁸ The current study of student logbook encounters enabled an assessment of whether:

1. The present course structure provides students with the necessary exposure to essential paediatric conditions
2. There is a relationship between case exposure and examination performance
3. Additional resources need to be put in place to support exposure to essential cases that present infrequently in clinical practice

5.2.2 Exposure to essential paediatric conditions

The review of student logbooks indicates that although students are being exposed to a broad spectrum of diseases, they have relatively low exposure to essential cases. In addition, students have inappropriately frequent exposure to the same case and/or cases of low educational importance. At the end of their paediatric clinical rotation, students are on average presented with only 19% of the 54 essential clinical cases.

In clinical training, the availability of appropriate case mix is a major variable and logistically impossible to control.²²⁹ The seasonal variation in the presentation of paediatric diseases is obviously an important factor that impacts upon the frequency of student exposure. Therefore, as the availability of patient mix is difficult to ensure, a list of essential patient problems needs to be defined, as indeed has been recommended by previous published studies.³⁴ This is more realistic, not only in terms of how patients present: i.e. with presenting complaints as opposed to diagnoses, but also stresses the importance of clinical reasoning and problem solving skills.

The students in this study spend two weeks in a paediatric unit in a district general hospital and two weeks in a tertiary paediatric hospital. However, the increasing specialisation within tertiary teaching hospitals may lead to under-representation of common paediatric conditions that are essential for student learning. In order to

circumvent this problem, students may need to spend an increasing amount of time in paediatric units in district general hospitals where exposure to essential cases is more likely.

5.2.3 Case exposure and examination performance

From the statistical analysis of case exposure and examination performance, the results indicated that total examination scores and total clinical scores did not depend on the number of cases seen. This supports previous published research showing that performance in knowledge-based examinations is independent of clinical experience.³⁸ Although no previous studies have found a direct relationship between the number of patient contacts and examination performance, it is universally accepted that adequate clinical exposure is essential if students are to become competent doctors. However, the learning effects of merely seeing patients are questionable and it is unclear whether supervision and feedback improves learning.²³⁰ Previous studies have shown that student compliance in completing logbooks is poor.³³ Therefore, in order to maximise compliance within the current study institution, students are only asked to document 20 supervised clinical cases i.e. cases in which they had an active role in taking a history or performing an examination and presenting their findings. It was felt that maintaining this high level of supervision and feedback would be important in optimising learning from patient encounters. In addition, the competing demands of clinical practice make it difficult for students to find staff members with the time or indeed motivation to supervise clinical cases. Therefore, it was not feasible to increase the number of cases that students are required to present. The results indicated only a weak correlation between the number of supervised cases seen and students' end of course mark, end of year clinical case and final paediatric mark. This raises questions about the role supervision has to play in optimising student learning.

5.2.4 Need for additional resources to support exposure to essential cases that present infrequently in clinical practice

It can be difficult to ensure that students gain exposure to those essential conditions that may present infrequently in clinical practice. However, it is crucial that students

gain an understanding of how these conditions present in order to ensure that they have the necessary skills and knowledge to recognise them. In 1998, the Council on Medical Student Education in Paediatrics (COMSEP) reported that students do not have enough time to gain competencies in areas such as child abuse, genetics and adolescent medicine.²³¹ The current study produced similar findings with poor student exposure to a variety of essential cases (such as child abuse, meningococcal septicaemia and heart failure) that present infrequently in clinical practice. Students may continue to have major deficits in their experience unless the traditional clinical apprenticeship style model is augmented by additional experiences that address these deficiencies. In 1999, the Association of American Medical Colleges called for the development of effective and innovative educational technology applications to enhance and standardize student learning.²³²

5.2.5 Conclusion

The review of student logbooks enabled an evaluation of current undergraduate training in paediatrics. The findings indicate that students are not receiving equivalent educational experiences to one another. During the course of their rotation, they are being exposed to a broad spectrum of different diseases but have relatively little exposure to essential cases. In addition, they have inappropriately frequent exposure to the same case and/or cases of low educational importance. The study found a weak correlation between case exposure and examination results. Therefore, the learning effect of case exposure and the degree to which supervision and feedback improves learning remains unclear.

The findings highlight the need to provide more structure to students and clearer guidance for students on the type of cases they should be exposed to during the course of their training. However, this approach is unlikely to address the issue of exposure to cases that are essential but present infrequently in clinical practice. This presents a challenge for educators and supports the notion of using technology to help standardize educational experiences. However, the development of online learning resources runs the risk of moving education further away from the cornerstone of medical education i.e. learning from patients at the bedside. There are several different technological applications that can be considered to address this

problem. However, the author proposes that the Virtual Patients model may help overcome this problem by facilitating student exposure to essential cases that present infrequently in clinical practice, while still ensuring that case exposure occurs in a realistic, albeit virtual environment.

5.3 Acceptability of Virtual Patients

5.3.1 Introduction

The importance of user acceptability is the first level in Kirkpatrick's evaluation learning model. In order for any learning resource to be effective, it must be accepted and valued by its users. As a result, we have seen a growing number of research publications contributing towards an evidence base to help guide the development and integration of Virtual Patients into the curriculum.⁶⁸ Most published research is quantitative in nature, with qualitative methodology being infrequently used.⁶⁷ However, in order to uncover more about peoples' learning experiences, a more in-depth approach is needed. In order to answer research question 2.1, 'Do undergraduate students and postgraduate trainees view an online Virtual Patient module as an acceptable learning tool?', three separate evaluations were undertaken. The focus group study provided insight into the factors that facilitate student learning within a virtual environment. Students learn from engagement, interaction and participation in integrated modules that they recognise as relevant and reliable. The Virtual Patient evaluation questionnaire proved to be a practical, valid and reliable tool for measuring both the impact on learning and content and design of the Virtual Patient module and mirrored many of the findings of the focus group discussion. Finally, the case discussion among Basic Specialist Trainees expanded the role of the Virtual Patient by confirming that trainees also valued the Virtual Patient as a learning resource.

5.3.2 Psychometric properties of student questionnaire

The final 11-item questionnaire consists of two factors with high reliability: (i) impact on learning and (ii) module content. Given the reliability and validity findings, the evaluation tool appears suitable for measuring students' opinions of and

attitudes to the Virtual Patient module. The feasibility of the questionnaire was demonstrated by the high response rate, with all students who finished the Virtual Patient module completing the evaluation questionnaire.

5.3.3 Participation

According to Lave and Wenger, learning is a process of social participation in a community of practice.²² Members join a community and initially learn at the periphery. Then, as their confidence, competence and understanding of the community grow, they take a more active, central role in the community. The goal of medical education can, thus, be viewed as enabling students to progress from 'legitimate peripheral participation' into 'full participation'. However, in order to participate, deliberate exposure to clinical cases and the working environment is needed. During the focus group, it became clear that students recognised that participation is central to learning. Students and postgraduate trainees who completed the questionnaire agreed that it raised their awareness of the difficulties surrounding the diagnosis and management of child abuse. As a student or junior postgraduate trainee, opportunities to learn from cases of suspected child abuse are limited. Of the twenty students who participated in the focus group, only one had seen a case of suspected child abuse during their paediatric rotation. 22% of students who completed the online questionnaire reported being involved in a case of suspected child abuse. However, in the focus group it emerged that their level of involvement was minimal. Within the Virtual Patient module, students valued being part of a patient's story, they learned from participating, following and shaping how the case progressed.

5.3.4 Authenticity

Students need to believe virtual cases are true reflections of a patient's journey. Therefore, maintaining authenticity is key. During the focus group it emerged that one of the strengths of the Virtual Patient module came from the use of video scenarios with professional actors, defined scripts and realistic settings. Students and trainees who completed the questionnaire agreed that the module reflected real life situations. These findings contrast with previous published research, that claims

authenticity can be achieved by the use of photos alone.⁶⁹ This may be because the majority of existing Virtual Patients are concerned with the development of clinical reasoning and are digitally constructed for that purpose. This study's Virtual Patient module is concerned with more than just the acquisition of clinical knowledge. Professional roles and responsibilities, communication skills and inter-professional relationships all influence how patients are managed in the clinical setting. However, structuring opportunities for students to learn from participation on the wards, in clinics and in the Emergency Department remains challenging. Virtual Patients provide a means to overcome this by constructing a learner-centred virtual reality that can support learning in an authentic, albeit virtual, environment.

5.3.5 Integration

The teaching of professionalism in undergraduate medical education has traditionally relied on the hidden curriculum to instil in students the values, attitudes and beliefs of professionalism.²³³ Although role modelling is of primary importance, as Ludmerer states, professionalism cannot be taught *ex cathedra*; as role modelling does not guarantee excellence.²³⁴ We need to both explicitly teach and assess professionalism. Students in the focus group recognized that integrating the teaching and assessment of professionalism into the Virtual Patient module was valuable, since it enabled them to focus on acquiring clinical knowledge while, at the same time, gaining a deeper understanding of professional norms in challenging situations. Student and trainee responses to the questionnaire mirrored this opinion, with respondents agreeing that the module helped them reflect on professional issues while at the same time identifying deficits in their knowledge. Both the focus group discussion and questionnaire responses strengthened the notion that the teaching of professionalism should be an integrated part of the curriculum.

5.3.6 Reliability and relevance

Students and trainees who completed the questionnaire agreed that working through the module was a valuable use of their time. The focus group discussion provided further insight into why the module was viewed as a valuable learning resource. Students are essentially searching for a 'one stop shop'; a learning resource, that they

could be confident is reliable and relevant and provides comprehensive coverage of curricular requirements. Given the wealth of learning resources available for students both within their own institution and online, it is not surprising that students can become overwhelmed. For students, the Virtual Patient module met their requirement for a 'one-stop shop' and was considered a valuable learning resource.

5.3.7 Engagement

There are three types of cognitive load that may be imposed on a learner: intrinsic, germane and extraneous. Intrinsic load is imposed as learners try to integrate new information into existing knowledge structures. Germane load is the cognitive load required to process intrinsic load. Finally, extraneous load is that load imposed by all unnecessary stimuli.²³⁵ In the creation of a Virtual Patient module, the challenge is to balance all three; to make the module engaging for students yet limit potentially distracting or excessive extraneous loads. Students who participated in the focus group discussion found the Virtual Patient module to be an engaging resource and preferable to text based learning. The intrinsic load, i.e. the recognition and management of child abuse, is an inherently difficult subject to teach and is immutable. However, germane and extraneous loads can successfully be manipulated to support learning and maintain engagement. It can be argued that the right balance of cognitive load was achieved.

5.3.8 Conclusion

In conclusion, the study found the Virtual Patient to be an acceptable learning tool at both undergraduate and postgraduate level. Furthermore, the Virtual Patient evaluation questionnaire was found to be a practical, valid and reliable tool for measuring both the impact on learning and content and design of the Virtual Patient module. The focus group provided further insights into why students found the Virtual Patient module to be a valuable learning resource. It supported learning through (i) engagement, (ii) interaction and (iii) participation in a module that students recognised as (iv) relevant and (v) reliable.

5.4 Virtual Patient and Clinical knowledge gain

5.4.1 Introduction

In order to determine whether completion of the online Virtual Patient module improves students' short-term and long-term knowledge and how this is influenced by the instructional methods used, answers to a pre and post module MCQ and PBL question on child abuse in the End of Year paediatric examination were analysed. This evaluation addressed level 2 of Kirkpatrick's Learning Evaluation Model. The results show that students who completed the Virtual Patient module scored higher on the post module MCQ, remembered information better when it was presented through auditory and visual means and performed better in the End of Year child abuse PBL, than did students who were exposed to the traditional curriculum only.

5.4.2 Academic strength and learning

Completion of the Virtual Patient module required students to engage in their own self-directed learning. Therefore, it is possible that academically weaker students may have been disadvantaged, as they may not have had the skills necessary to engage effectively in self-directed learning. However, academically low and high performing students demonstrated similar short-term knowledge gains, with mean MCQ scores increasing from 57% to 67%. Although academically stronger students were more likely to participate in the Virtual Patient module, multiple regression analysis showed that even after controlling for academic strength, completion of the module still had a significant effect on PBL scores. Child protection is a particularly difficult subject to teach. However, by presenting information in an interactive module with opportunities for feedback and self-assessment, it may, compared to passive learning methods, help students of all academic abilities gain and reinforce knowledge.

5.4.3 Instructional method used

Problem-based learning scores for the End of Year child abuse examination question and post module MCQ scores were significantly higher for information that was

presented through video scenarios than for information presented through text only. This suggests that the video scenarios stimulated cognitive processes more. This finding is in accordance with Mayer's multimedia principle of learning, and supports previous published research by Balslev et al., which demonstrated how the limited capacity of human working memory could be expanded by the use of visual and auditory information.⁹¹ This finding has implications for future Virtual Patient design and development and shows that learning is influenced not just by content but also instructional methods.

5.4.4 Virtual Patients compared to traditional curriculum

Students who completed the Virtual Patient module had statistically significant higher scores on the End of Year child abuse PBL question than did students who completed the traditional curriculum alone. There are several possible explanations for this finding. As previously highlighted in subsection 6.2.4, students have limited exposure to child protection cases during the course of their clinical training. Therefore, it is likely that students, who chose not to participate in the module, did not have the opportunity to learn from an actual child protection case during the paediatric course. For those students, who had the opportunity to learn from a case, it is unlikely, given the brevity of available clinical time, that they were able to follow the patient's story from initial presentation to subsequent management. Therefore, opportunities to maximise the learning potential of the case may have been lost. Students exposed to the traditional curriculum alone had the opportunity to complete a camptasia lecture online and attend a problem-based learning session incorporating child protection. However, one of the main disadvantages of paper-based cases is that they do not realistically simulate the challenges of problem solving in the clinical environment.²³⁶ The traditional curriculum may not have supported understanding and long-term knowledge retention as effectively as did the Virtual Patient that provided a structured learning experience in a realistic environment. This supports research by Kamin et al., who demonstrated that learners are better at retaining knowledge if it is learned in a relevant context.⁹⁰

5.4.5 Long-term knowledge retention

In 1885, Hermann Ebbinghaus first described the exponential nature of forgetting i.e. that forgetting is an expected natural phenomenon.²³⁷ Based on Ebbinghaus' theory of memory loss, it could have been hypothesised that students in group 1 would have a greater decline in knowledge over time than students in group 4. However, the results showed no difference in scores for the End of Year child abuse PBL across groups. Students who completed the module just before their End of Year exam scored similarly to students who had completed the module nine months earlier. This suggests a further advantage of video-based learning modules. How quickly individuals forget is dependent on a number of factors including the inherent difficulty of the subject matter, physiological factors, individual differences, time and its representation. Most factors were outside of the control of the study. However, the means by which information was represented in the module may have supported long term knowledge gain and overcome the decline in memory with time. According to cognitive theory, learners are better at storing and retrieving knowledge if it is learnt in a relevant context environment similar to the workplace.²³⁸ By creating a realistic clinical context within a virtual learning environment, learning and knowledge retention may have been shifted from lower to higher hierarchal levels.

5.4.6 Conclusion

The findings provide evidence that the use of an online interactive video-based Virtual Patient module to teach undergraduate medical students about the recognition and management of suspected child abuse can support student learning and long-term knowledge retention. Video based learning may promote more effective knowledge gain than text based learning. Teaching about child abuse through virtual means can serve to complement traditional clinical teaching by providing structured educational encounters to important cases which students may not have the opportunity to learn from during the course of their clinical training.

5.5 Virtual Patients and professional identity

5.5.1 Introduction

Medical professionalism is comprised of a set of values, behaviours and relationships that underpin the social contract between the public, the medical profession and doctors.²³⁹ In order to determine whether the Virtual Patient module has a role to play in the development of students' professional identities, Basic Specialist Trainees were first asked to validate pre-set answers to professional dilemma scenarios in the module and, secondly, undergraduate students' responses to the scenarios were analysed to determine whether written feedback helps them learn about professional norms and change their behaviour.

5.5.2 Professional norms

Previous studies have found that faculty often disagree as to what constitutes professional and unprofessional behaviour.^{173,174} The main character in the videos used in this study was a paediatric doctor in the early stages of her postgraduate training. Having completed their internship, Basic Specialist Trainees have one to two years' experience in paediatrics, so they are at a similar stage in training to the main character. The dilemmas that she faces in the module were developed to reflect those that trainees might encounter early in the course of their training. All but one postgraduate trainee chose the 'ideal' answer on their first attempt to all three professional dilemma scenarios. It was therefore considered that the response of postgraduate trainees provided validation of the 'ideal' answers developed by academic staff and agreement regarding perceptions of professional norms.

5.5.3 Professional development

Previous research studies have indicated that what students view as professional or unprofessional behaviour varies by stage of training.²⁴⁰ The development of professional values and the understanding of professional norms is a process which extends from medical school right through to clinical practice.¹³⁹ Although students completing their paediatric rotation have several years experience in the clinical

setting, they have limited experience of working as a professional. The finding that students often took several attempts to reach the ideal answer compared to postgraduate trainees who have more experience was not surprising.

5.5.4 Role of feedback in developing professional identities

During the module there was a statistically significant decrease in the number of attempts required by students to reach the 'ideal' answer. There are several possible explanations for this. Firstly, it could be due to the different nature of each dilemma. Schuwirth proposes that professional behaviour, like problem-solving ability, is highly content and context-specific.¹⁴⁷ However, unlike most previous studies using individual vignettes describing professional dilemmas, those in the Virtual Patient module were connected and progressed logically. So it can be argued that response variations were not due to context or setting changes, as these remained stable. During the module, students received immediate feedback on their selected answers to professional dilemmas. The feedback was specific, giving an explanation of why their chosen answer was ideal or not. It can be argued that by providing students with written feedback during the module, students learned about professional norms and applied this knowledge to subsequent scenarios.

5.5.5 Conclusion

Postgraduate trainee responses provided validation of the 'ideal' answers to professional dilemma scenarios in an online video-based Virtual Patient module and agreement regarding perceptions of professional norms. By providing students with written feedback during the module, they learned about professional norms and applied this knowledge to subsequent scenarios.

5.6 Virtual Patients and Reflective Practice

5.6.1 Introduction

In recent years, reflection has become an increasingly important part of undergraduate medical training. Reflective capacity is an essential characteristic of

professionally competent clinical practice. However, for reflection to become an integral part of medical training and education, we need firstly to understand how to structure opportunities for reflection, we need secondly to encourage students to engage deeper with the reflective cycle and finally we need reliable and valid tools to measure reflective ability. To date, limited instruments are available. The majority of published studies describe the use of a variety of critical incident reports, questionnaires, essays and reflective portfolios. However, the author was aware of no reports on the use of a semi-structured, observer-rated instrument to measure responses to reflection evoking videos within a Virtual Patient module.

In order to answer research question 2.4, 'Do Virtual Patients promote reflective practice?', a semi-structured, observer-rated instrument was adapted and used to measure the reflective ability of students by analysing their responses to reflection evoking scenes within the Virtual Patient module. The findings demonstrated that the instrument could be adapted for measuring student responses to reflection evoking scenes, that the instrument has acceptable psychometric properties and that guided reflection can promote deeper engagement with the reflection cycle.

5.6.2 Reflection on experience

Aukes et al. define three cognitive emotional levels of a reflective practitioner: Reflection in action, reflection on action and reflection on experience.²⁴¹ They define personal reflection as 'The exploration and appraisal of one's own and others' experiences, thus clarifying and creating meaning for the benefit of balanced functioning, learning and development'. All three are required in order to function effectively and efficiently as a healthcare professional. Reflection on experience or personal reflection is the key to acquiring and maintaining balanced professionalism across the continuum of medical education.²⁴² Attempting to measure any one of these levels is challenging. However, reflection on experience remains the most difficult construct to measure and is the most under-studied. During their undergraduate education, students have limited insight into the realities of working as a doctor. Therefore, their experiences and opportunities to reflect personally on those experiences are narrow.

Many authors have attempted to overcome this problem and encourage reflection on experience through the use of written scenarios describing potentially challenging situations that students may encounter as junior doctors.¹⁹⁵ However, written scenarios are limited. They are limited to the extent that they are able to replicate the actual clinical environment, the personalities involved, the interactions between people, the complexity of patient care and the effects of unspoken words or actions. Technological advances and the use of digital media offer opportunities to overcome these challenges and open doors for students. Technology now enables students to become part of the hidden world that takes place on wards and in corridors, where doctors and healthcare professionals struggle to deal with, and learn from, the multitude of personal and professional challenges they face.

An average of 78% of students in this study documented their reflections in response to the video scenes, with a mean score of 4 for the five reflection scenes. This compares favourably to the scores achieved by Boenick et al.¹⁹¹ Providing students with opportunities to reflect personally on authentic replications of hospital life within a video-based Virtual Patient module, can not only facilitate personal reflection but may also motivate students to engage in reflective practice. This provides further evidence that the use of interactive digital storytelling not only increases student engagement but also increases the depth of reflection.²⁴³

5.6.3 Additional factors influencing student reflections

Although the average number of student reflections was high at 3.97, students were less likely to reflect as they progressed through the module. The time taken to complete the module may have accounted for students not attempting all the reflective scenarios. Boenink et al. suggest that circumstances may influence students' reflection scores.¹⁹¹ Although not statistically significant, the authors found that students' post test scores for a semi-structured questionnaire on reflection-evoking case vignettes were slightly lower than pre-test scores. The authors speculated that student fatigue might have accounted for these differences.¹⁹¹ In this study, although, there was a statistically significant decrease in reflection scores as students progressed through the module, the lowest score was for scene 4, suggesting

that the content of the scene, rather than fatigue, may have had more influence on students' motivation to reflect.

An alternative explanation could be that students may have reflected privately but did not wish to document their reflections. This explanation is supported by the finding that there was no statistically significant difference between reflectors and non-reflectors in response to the questionnaire statement 'the module helped me to reflect on professional issues'. This suggests that even though non-reflectors did not document any written thoughts, they still reflected on the scenes. This supports previous published research by Grant et al. who suggest that many students perceive themselves to already be reflecting and that the written process may not align with their preferred learning style.¹⁸⁹ Vivekananda-Schmidt et al. suggest that student concerns regarding privacy and uncertainty about who might read their reflective accounts may impact upon what students chose to reflect upon.²⁴⁴ In the present study, all data were anonymised and did not contribute towards students' formative or summative assessment. It was unlikely that concerns regarding privacy would have influenced students' decisions to document their reflections. It seems more likely that they may have reflected, but this was not detected by merely assessing their written responses to the reflective scenes and perhaps group discussion may have aligned more with the learning preferences of the Net Generation²⁴²

5.6.4 Gender and reflection

There was no gender difference found between students who documented reflections (reflectors) and students who failed to document any reflections (non-reflectors). This supports previous published research by Carr & Carmody.¹⁹⁰ However, among the reflectors, females demonstrated higher reflective scores than males in response to all five reflective scenarios. This difference was statistically significant in scenarios 3 and 4. Amy, the lead character in the module, represents a female paediatric trainee doctor. It may be that female respondents were better able to relate to Amy, particularly in scenarios 3 and 4 where she has a particularly difficult encounter with the mother of the child and in scene 4 where her male consultant subsequently reprimands her for her handling of the encounter with the mother. These findings support previous published research by Boenink et al, who found that

female students gained higher scores on reflection than did male students in response to paper based vignettes.¹⁹¹

5.6.5 Academic performance and reflection

There was no difference in academic performance between reflectors and non-reflectors. However, academically higher performing students scored higher than academically weaker students, although this only reached statistical significance in scene 4. This supports previous published studies. Lew et al. studied the reflection journals of 690 first-year applied science students.²⁴⁵ The authors found that self-reflection on how and what students have learned leads to a small improvement in academic outcome. Deep approaches to learning are more likely to occur in association with reflective practice.¹⁹⁵ Moon states that the iterative process involved in reflection may be key to transitioning from a surface towards a deeper approach to learning.²⁴⁶ Since deep approaches to learning are associated with improved academic performance, it is not surprising that academically higher performing students engaged in deeper reflection.

5.6.6 Degree status and reflection

Older students and students who had completed a degree prior to entering medical school were significantly more likely to document their reflections. This supports previous published research by Fanning and Chadwick that found graduate entry students to be reflective learners¹⁹³, and supports the idea that reflection is a developmental process that improves with age and experience. In the current study, postgraduate students had higher overall reflective scores compared with undergraduate entrants. This difference reached statistical significance for three of the five scenes. The findings support previous published research and can be explained by several possible reasons.¹⁹⁴ Postgraduate students may be more familiar with reflection, having recognized the benefits of reflective practice during previous degrees. They may already have experience in the workplace and have used reflection to learn from experience in previous employment. Finally, postgraduate students are generally older than undergraduates and the higher scores achieved may reflect a maturational effect for older learners to reflect more deeply.

5.6.7 Guided reflection

In the literature, there are descriptions of several reflective models that have been developed to help facilitate the reflective process. However, a review by Sanders et al. in 2009 identified only one study comparing different approaches to fostering reflection. Baernstein et al. conducted a randomised control trial to determine whether writing, one-to-one interviews or a combination of these interventions effectively elicited reflection on professional issues for undergraduate medical students.¹⁸⁴ The study found that students explored more professional issues during a thirty-minute interview than during a writing exercise. However, in everyday practice, with limited resources, constraints on available faculty time and increasing student numbers, opportunities to conduct one to one interviews with students is not feasible. Mann et al. recommends that learners be given a structure to guide the complex process of reflection.¹⁹⁵ However, according to Sandars, there are significant workload implications for the introduction of guided reflection in any curriculum.²⁴² Therefore, a more practical solution is needed.

At the start of the Virtual Patient module all students were informed about the nature and value of reflective practice and the influence it has on learning. Students in group A were prompted to reflect by the use of an open ended question only. Students in group B were given prompts or headings, based on the elements of professionalism endorsed by the American Academy of Paediatrics, which made explicit the components of critical reflection to be explored.²¹⁹

The number of reflectors and non-reflectors was the same for the two groups. However, in all scenarios, students who had received guidance scored higher than students who had not, the difference being statistically significant in four scenarios. This provides clear evidence that students' ability to engage in deeper reflection can be facilitated by the use of written guidance in a virtual learning module. However, although facilitating reflection through guidance may improve reflective ability, it may not encourage students who do not have a natural tendency to reflect to engage in the reflective process. This supports the notion that the ability but not the tendency to reflect is amenable to intervention.

5.6.8 Reliability and construct validity

The inter-rater reliability for all five scenarios was good at > 0.8 , providing good evidence that the reflective passages were consistently rated appropriately. The strong correlations between all five scenarios and between the overall score and different perspectives support the internal validity of the instrument. Female students, students who had completed a previous degree and academically stronger performing students had higher reflective scores, supporting the construct validity of the instrument.

5.6.9 Correlation between videos

Higher correlations for the video base reflection scenes were found than those found by Boenink et al. in 2004.¹⁹¹ In that study, written case-vignettes were used. The correlation between scores for cases 1 and 2 was 0.35 and for cases 3 and 4 was 0.41. In the current study, the correlation between overall reflection scores for the five reflection scenes in the Virtual Patient module was 0.5-0.7. The findings of higher correlations between reflection scenes may be because the video scenarios are all interlinked and logically progress from one scene to another, unlike the study by Boenink et al. where the content of the case vignettes is unrelated.¹⁹¹ In contrast, as the story unfolds in the Virtual Patient module, students are able to continually reflect back on previous scenes and relate them both to the current scene and the overall story.

5.6.10 Correlation between the different perspectives and overall reflection scores

Correlations between the different perspectives and overall reflection score were positive except for personal feelings. This is not surprising, as students who mentioned personal feelings often just expressed their immediate emotional response to the scene with no further exploration of perspectives or balancing of opinion. The perspectives mentioned by students differed for each reflection scene, as the scenes differed in the order of importance and number of possible perspectives. For example, in reflection scene 1 involving the Radiology Consultant and Amy,

important perspectives were those of doctor, ethical, educational and health professional. In contrast, in reflection scene 2, involving the mother and the consultants, important perspectives were ethical, family, health professional, legal, medical and patient. Overall, the health professional perspective was the leading perspective mentioned either once (average of 37 times in each scene) or extensively (average of 7 times in each scene), followed by doctor perspective and professionalism. The perspectives of doctor and professionalism were mentioned at least once, an average of 32 and 34 times, respectively, in each scene. However, only professionalism consistently correlated with a high overall score, with doctor and health professional correlating moderately to strongly. The fourth most common perspective mentioned was personal opinion, which had a weak to moderate correlation with the overall score.

5.6.11 Conclusion

A semi-structured, observer-rated instrument developed to measure reflection on professionalism in medical practice can be adapted for measuring student responses to reflection evoking video based scenes within a Virtual Patient module and has acceptable psychometric properties. Female students, academically higher performing students and postgraduate students are more likely to engage in deeper reflection. Facilitating reflection through guided reflection improves reflective ability but may not encourage students who do not have a natural tendency to reflect, to engage in the reflective process.

5.7 Limitations of the study

Apart from the postgraduate trainee evaluation, all studies described were conducted at a single institution. This may limit generalisation of findings. However, the sample size was large, covered a broad age range, was made up of both graduate entry and undergraduate students, and represented a diverse range of nationalities. Therefore, it can be argued that the cohort was representative of many medical schools across the country.

The assessment of the current undergraduate curriculum was limited to a quantitative review of student logbooks. Further qualitative research may have contributed more information about why students were not gaining exposure to essential cases during their paediatric rotation. However, as outlined above, the factors that influence case availability have previously been described in the literature and the purpose of the review was not to contribute further to this research, but to determine those essential cases that are known to present infrequently in clinical practice and should be addressed in the Virtual Patient module.

A further limitation of the study is that only one area i.e., the recognition and management of child abuse was studied. However, the concept of integrating clinical knowledge, the teaching of professionalism and the promotion of reflective practice into a single module can be adapted for any clinical case.

The Virtual Patient evaluation questionnaire was developed to evaluate students' opinions of a single module concerned with the recognition and management of suspected child abuse. Many of the items are module specific. However, a variety of sources were used to generate the items for the questionnaire, including previous qualitative research concerning a different Virtual Patient module. Therefore, it can be argued that the questions can be modified to suit future Virtual Patient modules by adjusting module specific questions, while still maintaining the structure and content of the questionnaire.

Although there was a strongly positive response to the Virtual Patient module, with 81% of students completing the module online, the study did not provide insight into why 19% of the class did not complete the module. This would have been an interesting area for study and may have provided further insight into how to construct modules that address the learning needs of all students.

The study showed that through feedback students could learn about professional norms and apply this knowledge to subsequent scenarios. However, this gives no indication about whether students are able to apply and adapt this knowledge to future real life clinical scenarios. Similarly, it can be argued that although students reflected within a Virtual Patient module, they may not engage in reflective practice

in response to real life experiences. Therefore, although the evaluation did attempt to address Level 3 of Kirkpatrick's Learning Evaluation Model, it was limited to behaviour change that occurred within the module and did not determine if positive change transferred to clinical practice.

5.8 Conclusion and recommendations for future study

This thesis has demonstrated a need to augment the traditional undergraduate paediatric curriculum to ensure all students receive equivalent educational experiences. Although, there are several different approaches that could be considered, in an effort not to move clinical teaching further away from the bedside and actual clinical practice, the author explored the development of and evaluation of an online video-based Virtual Patient to support not just student learning, but also professional development and reflective practice.

By triangulating the findings from three separate evaluations, the study found that students viewed the Virtual Patient as an acceptable and valuable learning tool. A practical, reliable and validated tool for assessing the impact of learning and module content and design was developed. Future studies are needed to determine whether the questionnaire can be modified to evaluate different modules, by adjusting module specific questions, while still maintaining the structure and content of the questionnaire.

In addition, the focus group findings highlighted five factors that influence how students view Virtual Patients. These factors can be used to inform the development of future modules and contributes to the growing literature on learner views of Virtual Patients as an educational resource.

The study showed that Virtual Patients support not just short-term knowledge gain but also long-term knowledge retention better than the traditional curriculum alone. This has important implications for clinical practice and supports the development of future Virtual Patients to augment the delivery of undergraduate education. To determine whether the findings can be generalised to students in other institutions, future studies should explore the use of the Virtual Patient in other medical schools

and with different student cohorts. Furthermore, it was demonstrated that the Virtual Patient could also be used to support learning at postgraduate level. This provides a very cost-effective means of developing Virtual Patients and sharing resources. Future studies may explore further how Virtual Patients can be adapted for use by multiple learner levels.

It was established that presenting information in video format, where students were able to interact with the video, had a greater effect on learning than information presented in text format. This has important implications for the design of future Virtual Patients and reinforces the importance of the effect of multimedia type used on learning outcomes and the benefits of integrating videos into Virtual Patient modules.

It was shown that students' responses to professional dilemma scenarios could be improved through the use of written feedback in an online module. Although a positive effect on behavioural change within a virtual environment was demonstrated, further research is needed to determine if learning about professionalism in an online environment generalises to other situations and real life clinical practice.

Several important findings about the development of student reflective capacities were demonstrated. Firstly, that it is possible to engage students in reflection while simultaneously teaching clinical knowledge and positively influencing change in professional behaviour. Secondly, a validated tool was successfully adapted for measuring reflective abilities. This tool can be used to assess reflective abilities in other video-based Virtual Patient modules, thereby providing a valid and reliable assessment of student abilities. Thirdly, factors that influence students' reflective ability were demonstrated. Fourthly, it was shown that it is possible to promote deeper engagement in the reflective cycle by the use of guided reflection. Finally, it was demonstrated that although guided reflection improves students' ability to reflect, it may not encourage students who do not have a natural tendency to reflect, to engage in the process.

In this study, several advantages of the use of video-based Virtual Patients to teach students about the recognition and management of suspected child abuse were shown. However, the results of the student logbook review illustrated that there are numerous other cases to which students do not gain exposure in clinical practice. Future studies should determine if Virtual Patients could similarly support learning about a variety of different clinical cases while simultaneously supporting the development of students' professional identities and reflective abilities. .

5.9 Summary

The research reported here was designed to determine whether (i) current undergraduate training in paediatrics is adequate in the area of child abuse or whether there is there a need to supplement it to ensure that all students receive an equivalent educational experience and (ii) whether Virtual Patients provide an effective learning tool in this area of undergraduate education.

Using a mixed methods approach in 181 undergraduate medical students and 25 postgraduate trainees, it was established that the current curriculum did not provide adequate exposure to essential infrequent cases in clinical practice and all students were not receiving equivalent educational exposure. In order to address this deficit, a new approach was developed and assessed.

A Virtual Patient module was developed *de novo* and this proved to be an acceptable learning tool. A new measure developed for evaluating its impact was found to be practical, reliable and valid. Compared to the traditional curriculum alone, undertaking the new module significantly improved short-term learning and long-term knowledge retention. Providing students with written feedback during the module improved their learning about professional norms and their ability to apply such norms to clinical scenarios. A semi-structured, observer-rated instrument was shown to have acceptable psychometric properties as a measure of students' responses to videos designed to evoke reflection. Female, postgraduate and academically higher performing students were significantly more likely to engage in deeper reflection. Guided reflection improved students' ability to reflect, but may not

encourage students who do not have a natural tendency to reflect, to engage in the process.

In conclusion, the new Virtual Patient module was an acceptable learning tool for improving clinical learning while simultaneously promoting the development of professionalism and reflective abilities in undergraduate medical students.

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Appendix 1

INFORMED CONSENT FORM FOR ONLINE VIRTUAL PATIENT MODULE **The Virtual Patient Project**

Contacts: Dr Michelle McEvoy, The Children's University Hospital, Temple Street, Dublin 1. drmichellemcevoy@gmail.com. & Prof Geraldine MacCarrick, Department of Medical Education, RCSI, Dublin

By clicking on the icon below, you will be acknowledging that you have been given the following information with respect to your participation as a volunteer in a research project being conducted by Dr Michelle McEvoy.

- **Purpose of the study:** This project seeks to research how Virtual Patients can be used as an educational tool to enhance learning at both an undergraduate and postgraduate level.
- **Procedures to be followed:** You will be asked to complete the online Virtual Patient module. Your interaction with, and responses to, the module content will be analysed as part of the educational research project. The unique username and password which you have been issued will ensure your anonymity.
- **Participation is voluntary:** Your participation in the online Virtual Patient module is voluntary. You are free to leave the module at any time.
- **Discomforts and risks:** There are no known discomforts or risks. The online Virtual Patient module will not form part of your assessment in paediatrics.
- **Benefits to me:** The Virtual Patient has been developed to help improve your educational experience in paediatrics. We hope that your participation in this self directed learning module will help you learn not just clinical knowledge, but also enable you to explore and reflect upon the many professional difficulties that you may encounter when dealing with cases of suspected child abuse.

- **Benefits to education:** Research in this area is relatively new. Your participation will help contribute to research informed practice on the use of Virtual Patients in undergraduate education.

 - **Statement of confidentiality:** Every attempt will be made to ensure confidentiality. Only the researchers will have access to your anonymised responses. They will be stored on a password-protected database.
1. I confirm that I have read and understand the information sheet for the above study.
 2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving reason.
 3. I agree to my responses being analysed as part of an educational research project.
 4. I agree to the use of anonymised quotes in publications.

Please **[CLICK HERE](#)** to enter the online Virtual Patient module

Appendix 2

INFORMED CONSENT FORM FOR FOCUS GROUPS

The Virtual Patient Project

Contacts: Dr Michelle McEvoy, The Children's University Hospital, Temple Street, Dublin 1. drmichellemcevoy@gmail.com. & Prof Geraldine MacCarrick, Department of Medical Education, RCSI, Dublin (Supervisor)

This is to certify that I, _____, have been given the following information with respect to my participation as a volunteer in a research project being conducted by Dr Michelle McEvoy.

A focus group interview brings together a small group of people to 'focus in' on one topic that is of interest to a researcher. Focus groups enable a trained facilitator to utilise the dynamics of the group to discuss topics in depth; the views of all the participants can be considered. The interaction among people in the group is one of the most important parts of the process.

- **Purpose of the study:** This project seeks to research how Virtual Patients can be used as an educational tool to enhance learning at both an undergraduate and postgraduate level.
- **Procedures to be followed:** You will be asked some questions and can answer and discuss these questions with others in the focus group. The session will last one hour and will be tape recorded. We will transcribe the tape recordings, removing any identifying information such as individual names and then will destroy the tapes. These are standard procedures for focus groups.
- **Participation is voluntary:** Your participation in the focus groups is voluntary. You may decline to answer any or all questions, and you are free to leave at any time.
- **Discomforts and risks:** There are no known discomforts or risks. Focus group participants will also be asked to respect each other's anonymity. The facilitator will remind participants that the discussion is confidential and that the specifics of the discussion or individuals involved should not be disclosed outside the session.

- **Benefits to me:** The focus group provides an opportunity for you to give your opinion about whether completion of the Virtual Patient was a valuable learning experience for you, and to share your ideas and perceptions about how future educational tools can be enhanced.
 - **Benefits to education:** Research in this area is relatively new. Your participation will help contribute to research informed practice on the use of Virtual Patients in undergraduate education.
 - **Alternative procedures which could be utilized:** In case you are not comfortable speaking in groups, we have provided a written “focus group follow-up” sheet which you can complete in private and return to the research team instead of participating in the focus group. You need not speak during this meeting, and can leave at any time, taking the “follow-up” sheet with you.
 - **Time duration of the procedures and study:** The focus group lasts one hour. If people wish to continue the discussion longer than one hour, we will continue but also provide the opportunity for participants to leave after one hour.
 - **Statement of confidentiality:** Every attempt will be made to ensure confidentiality. Only the researchers will have access to the audiotapes. Once there are transcribed all identifying information from the participants will be removed. Once identifiers have been removed, the only individuals who could identify your information are those who participated in this focus group with you.
5. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.
 6. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason and without any personal consequences.

- 7. I agree to the focus group being audio recorded
- 8. I agree to the use of anonymized quotes in publications

_____ Name of Participant	_____ Date	_____ Signature
_____ Name of Researcher	_____ Date	_____ Signature

If you have any questions about the focus group or the project in general, please feel free to contact:
 Dr Michelle McEvoy at drmichellemcevoy@gmail.com

**The Virtual Patient Project
 Focus Group Follow-Up**

If there is anything you wish to add to the focus group discussion, please feel free to write that information below or on a separate sheet, making sure that any separate sheet is headed "Focus Group Follow-Up." Please do NOT provide your name or any other identifying information in this follow-up. Follow up sheets should be addressed to Dr Michelle McEvoy and left in my mailbox in George's Hall or mailed to:

Dr Michelle McEvoy, Paediatric Clinical Lecturer, The Children's University Hospital, Temple Street, Dublin 1

If you have any questions about the focus group or the project in general, please feel free to contact:

Dr Michelle McEvoy at drmichellemcevoy@gmail.com

The topics covered in the focus group session were approximately as follows:

- 1.
- 2.
- 3.
- 4.
- 5.

YOUR FOLLOW-UP COMMENTS:

Appendix 3

Royal College of Surgeons in Ireland
The Research Ethics Committee
121 St. Stephens Green, Dublin 2, Ireland.
Tel: +353 1 4022373 Fax: +353 1 4022449 Email: recadmin@rcsi.ie

Dr. David Smith, Acting Chair
Ms. Stephanie O'Connor, Convenor



Royal College of Surgeons in Ireland
Coláiste Iúroga na O'Dáinleá in Éirinn

RCSI

20th October, 2010

Dr Michelle Mary McEvoy,
Apartment 84,
Chapelgate,
Drumcondra,
Dublin 9

Ethics Reference No:	RECS588
Project Title:	Evaluation of Virtual Patients
Researchers Name:	Dr Michelle Mary McEvoy
Other Individuals Involved:	Professor Geraldine MacCarrick, Medical Education, RCSI. Professor Alf Nicholson, Paediatrics, RCSI.

Dear Dr Michelle Mary McEvoy,

Thank you for your Research Ethics Committee (REC) application.

We are pleased to advise that ethical approval has been granted by the committee for this study.

This letter provides approval for data collection for the time requested in your application and for an additional 6 months. This is to allow for any unexpected delays in proceeding with data collection. Therefore this research ethics approval will expire on **20th April, 2013**.

Where data collection is necessary beyond this point, approval for an extension must be sought from the Research Ethics Committee.

This ethical approval is given on the understanding that:

- All personnel listed in the approved application have read, understand and are thoroughly familiar with all aspects of the study.
- Any significant change which occurs in connection with this study and/or which may alter its ethical consideration, must be reported immediately to the REC, and an ethical amendment submitted where appropriate.

We wish you all the best with your research.

Yours sincerely,

A handwritten signature in black ink, appearing to be 'Stephanie O'Connor'.

PP Ms. Stephanie O'Connor (Convenor)
Dr David Smith (Acting Chair)



1810-2010
St. Stephen's Green

Appendix 4

Virtual Patient presentations, publications and awards

- McEvoy M, Butler B, MacCarrick G. **Teaching professionalism through virtual means.** *Clinical Teacher* 2012, 9(1): 32-36
- McEvoy M, Butler B, MacCarrick G, Nicholson AJ. Virtual Patients: An effective educational intervention to improve paediatric Basic Specialist Trainee education in the recognition of suspected child abuse? *Ir Med J* 2011; 104(8): 250-252
- McEvoy M, Butler B, Higgins S, Nicholson A, MacCarrick G. Teaching and learning about child abuse: The impact of an online multimedia Virtual Patient module on student learning. I
Irish Network of Medical Educators Meeting 2011
Irish Paediatric Association Meeting (Oral Presentation) June 2011
- McEvoy M, Nicholson A. **Student Case Exposure: Do we need to case-mix it up?** Irish Paediatric Association Meeting (Oral Presentation) June 2011
- McEvoy M, Butler B, Higgins S, Nicholson A, MacCarrick G. Teaching and learning about child abuse: Student evaluation of an online interactive Virtual Patient module. Irish Network of Medical Educators Meeting 2011
- McEvoy M, Nicholson A. Virtual Patients: An effective educational intervention to improve Senior House Officers' education and training in the management of suspected child abuse? European Academy of Paediatrics Meeting (Poster presentation) October 2010
- Winner of Irish Network of Medical Educators' Best Poster Prize 2011
- Awarded educational grant from National Academy for Integration of Research, Teaching and Learning (NAIRTL) 2010
- Shortlisted candidate for the 2011 Jennifer Burke Award for Innovation in Teaching and Learning (Irish Learning Technology Association and Dublin City University)