

THE INFLUENCE OF A CASE BASED WIKI ON PHYSIOTHERAPY STUDENTS' CLINICAL REASONING DEVELOPMENT

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Abstract

Clinical reasoning is a vital skill for physiotherapy professional practice and can be thought of as the thinking and decision making processes used in clinical practice. Learning experiences in traditional pre-registration physiotherapy courses may neglect the development of clinical reasoning and thus the link between theory and practice where clinical reasoning is embedded into the curriculum within other subjects. A new case based, cardiorespiratory, technology enhanced learning module was introduced to second year BSc (Hons) Physiotherapy students on a traditional course, with the aim of improving the link between theory and practice and developing clinical reasoning. Students were asked to participate in wikis in small groups to develop problems and treatment plans for six patient cases. The introduction of a wiki allowed students to practise skills required for clinical reasoning, such as evaluation and making treatment decisions but it also changed the underlying pedagogy for the new module to a constructivist approach rather than a behaviourist approach. It was unclear how this would influence the students' learning and their development of clinical reasoning. This research sought to develop an understanding of these issues.

A constructivist approach based on Vygotsky's sociocultural theory allowed analysis of how the wiki is interconnected with both the theoretical and clinical parts of the physiotherapy course and what part it plays in the development of clinical reasoning. Wiki texts from two groups of students from the 2010 cohort of a BSc (Hons) Physiotherapy course, who participated in the technology enhanced learning cardiorespiratory module in the theoretical part of the course, were downloaded. Eight students from this cohort participated in focus groups and follow up interviews after they had started their clinical placements between June 2012 and May 2013.

Data from the wiki printouts, focus groups and interviews were analysed using thematic analysis informed by Vygotsky's sociocultural theory, to gain an understanding of clinical reasoning development, the dialectical relationship between theoretical and clinical learning experiences and how the wiki impacted on and mediated these experiences.

The analysis showed that the wiki played an important role in mediating the students' clinical reasoning development by putting the focus on the patient, allowing the students to practise clinical reasoning and critical thinking skills. This made reasoning on clinical placement easier, although the concept of clinical reasoning was 'fuzzy' at this time. Clinical reasoning developed further on placement by taking responsibility for the patient, writing notes, communication with supervisors, the occurrence of critical incidents and reflection upon these learning experiences, until clinical reasoning became 'simple'. This may reflect internalisation of the concept of clinical reasoning by these students. The dialectical analysis of the theoretical and clinical learning experiences highlighted that clinical reasoning had been talked about in this traditional course, but not explained and that students rarely carried out reflection on their learning in the theoretical part of the course.

The findings make an original contribution by showing the value of the wiki learning experience in the development of clinical reasoning. This may be lost in the process in a traditional course because of difficulties with the shift to a constructivist learning approach reflected in the stress caused by group working and a lack of time to reflect on learning in a packed curriculum.

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Declaration

I declare that the research contained in this thesis, unless formally indicated within the text, is the original work of the author. The thesis has not been previously submitted to this or any other university for a degree, and does not incorporate any material already submitted for a degree.

Signed:

Dated:

1. Chapter One: Introduction

The chapter gives an overview of the background, key themes and drivers for this research. The key terms used in the thesis are defined and the research question and aims of the research are stated. The chapter includes a summary of subsequent chapters' contribution to the thesis and concludes with a brief description of my professional role in relation to the research.

1.1. Background to the study

This research aims to examine whether the experience of participating in a case based wiki prior to clinical placement contributes to the development of the professional practice skill of clinical reasoning from the pre-registration physiotherapy students' perspective. In 2006, a course review and revalidation process of the BSc (Hons) Physiotherapy course required the cardiorespiratory module team to condense and reorganise their curriculum content within the new course and also gave the opportunity to re-think how students' learning was facilitated within the cardiorespiratory module. The learning outcomes of the cardiorespiratory module are wide ranging and state that on successful completion of the module a student will be able to:-

- Explain normal respiratory physiology and anatomy and the changes that can occur with cardiorespiratory pathologies
- Demonstrate safe and effective assessment and treatment for people with cardiorespiratory problems.
- Devise and implement rehabilitation programmes for patients with cardiorespiratory conditions
- Discuss outcome measures that could be used with people with cardiorespiratory problems
- Evaluate and discuss the evidence base for cardiorespiratory physiotherapy
- Discuss major cardiorespiratory pathologies and the physical, psychological and social consequences to the patient, carers and community
- Demonstrate an understanding of the role of the physiotherapist in the multidisciplinary team managing people with cardiorespiratory problems and the ability to work in a team.

Although a key component of the module is for the students to learn practical skills to treat patients with cardiorespiratory problems, the module team decided to base the new module around six patient cases incorporating e-learning in the form of blended learning, to try and encourage a deeper, more active and collaborative style of learning amongst the students, as well as to place greater emphasis on clinical reasoning. 'E- learning is defined in this research as:-

'...online access to learning resources anywhere and anytime...' (Holmes and Gardner, 2006, p14)

This definition may be considered dated in the fast-paced world of developing technology but has been chosen because it is all encompassing in terms of not specifying how the online learning resources are accessed or what these resources may be. However, the definition is focussed on how learning technologies can be accessed rather than the learning experience that the technology may provide. An alternative definition such as:-

'...any learning that uses ICT...' (Higher Education Funding Council for England (HEFCE), 2005, p5)

is also very broad and allows the inclusion of different types of online learning such as blended learning, mobile learning, and learning using different kinds of Web 2.0 technologies such as blogs or wikis. More recently the term technology enhanced learning (TEL) has been used to describe the application of digital technologies to learning (Joint Information Systems Committee (JISC), 2010) in an effort to place more emphasis on how learning may be improved with the use of technology. However, Kirkwood and Price (2014) note that it is difficult to find explicit definitions of the term TEL and that there does not seem to be a shared understanding of what the term means or whether technology does in fact enhance learning. The learning experience in this module combined e-learning in the form of participation in a wiki with face to face teaching, a form of blended learning. Blended learning can be defined as:

'...a holistic approach to learning that involves a blend of different approaches, eg. face to face and e-learning, the use of different technology based tools or the blending of classroom based and work based learning.' (Allan, 2007, p1)

It could be argued that blended learning is an out-moded term which has been superseded and replaced by TEL. As the terms e-learning, blended learning and TEL have been used in the literature to describe the kind of learning which took place in the module under consideration in this thesis, and had to be considered in searching the literature for this thesis, all three terms will be used throughout the document in relation to the literature.

1.2. Contextualising the problem

The new module replaced two cardiorespiratory modules, which taught cardiorespiratory theory and practice to students in a traditional manner during the second year of the course. This learning experience was underpinned by a behaviourist approach to learning (Merriam and Caffarella, 1999) and our students were well accustomed to this as the main pedagogical approach used in the course. The students had lectures about particular pathologies with supporting tutorials and practical skills sessions each week. The module was teacher led and

directed. The students were examined on the module content that they had learned so that they could progress to the next level. Although it appeared that students were achieving a satisfactory standard in this practice area, whilst they were on cardiorespiratory clinical placements, the students' learning appeared to be knowledge based, rather superficial and was supported by a largely passive process. Anecdotal feedback from clinical educators in the cardiorespiratory area of practice suggested that some students were having difficulty translating theory into practice.

At this time, staff within the university were also being encouraged to further develop and explore the possibilities of using e-learning within their existing teaching programmes. More emphasis was being placed on collaborative learning because collaborative working is a key skill for healthcare workers and has been shown to improve treatment results for patients, (Yan et al, 2007). A case based approach to the module, supported by an e-learning environment within which students could work together with their peers and tutors to produce suitable physiotherapy treatment plans for the patients in the cases, would theoretically allow the students to collaborate actively in their learning as well as make a stronger link between cardiorespiratory theory and practice.

As the cardiorespiratory content of the curriculum was also being condensed, it was felt by the module team that more emphasis should be placed on clinical reasoning in relation to cardiorespiratory problems and the development of these skills by the students. Clinical reasoning has been defined as:-

'...the sum of the thinking and decision-making processes associated with clinical practice.' (Higgs and Jones, 2008a, p4)

By developing and practising the skills related to clinical reasoning, students may be better placed to use these skills to treat a variety of patients in different settings once they started their clinical placements. The introduction of a case based wiki and the way in which it was designed allowed the students to focus on clinical reasoning to explain why they would treat the patients in the cases in particular ways. Clinical reasoning is largely embedded in other topics in our curriculum, for example in topics such as physiotherapy in musculoskeletal problems or physiotherapy in neurological problems and so the fundamental importance of clinical reasoning in physiotherapy practice can become lost to the students (Christensen, 2007). When the students start their clinical placements, clinical reasoning suddenly becomes very important because it is the main criterion on which their clinical placement educator will base their marks for the placement. For the second year undergraduate physiotherapy students, clinical reasoning marks make up 40% of the total marks from their first clinical placement. It is therefore important to find ways to help

students develop their clinical reasoning and also lay emphasis on these skills. It was possible that this could be achieved by changing the pedagogical approach in the theoretical part of their course to a case based TEL environment, thus introducing more emphasis on the patient and how the students working collaboratively could decide upon suitable treatments for the patient cases.

Sandstrom (2006) described how students' interest for deep learning and advanced reasoning was stimulated by the clinical relevance of case-based learning. Eraut (1994) explained how essential professional knowledge such as that related to clinical reasoning, may not be included in the syllabus. He also suggested that the speed of clinical practice for student practitioners may be too fast to allow adequate development of this knowledge, thus highlighting the need for educators to take some responsibility for facilitating the development of clinical reasoning in their students. Therefore a blended, case-based approach to learning, supported by wikis within which students work together in small groups with their peers and tutors to produce suitable physiotherapy treatment plans for the patients in the cases over a period of time, may allow students to collaborate actively in a supported environment to help develop their clinical reasoning skills prior to placement.

1.3. Why this study is important

The introduction of e-learning and the consequent shift in underpinning learning theory for the new module fundamentally changed the learning experience for the students. It is recognised that theories of behaviourism, cognitivism and socio-constructivism may all underpin e-learning in certain contexts (Holmes and Gardner, 2006). As the new module was based around six patient cases to focus and contextualise what the students needed to learn and with the introduction of collaborative e-learning, the underpinning learning theory moved dramatically towards constructivism. Constructivist learning theory emphasises meaning making or the active process of building knowledge rather than memorising and understanding knowledge (Somekh and Lewin, 2005). The students had keynote lectures, practical skills lessons and tutorials to support their learning and e-learning was introduced to help support the learning for module assessments, so the module became a blended learning module. Students worked in small groups within a virtual learning environment (VLE) using a wiki, to produce patient treatment grids which were used in their end of module assessments. The grids for the assessment were based on the six patient cases upon which the module is based. This change of emphasis in underpinning learning theory could have presented challenges for students in terms of what they think learning is, how they think they learn and the approaches that they adopt to learning. Cramphorn (2004) has suggested that the constructivist nature of e-learning can be a barrier to student learning in its own right,

especially in the early stages of the learning process and where students are more accustomed to traditional, tutor led learning experiences.

The cardiorespiratory module team considered that the use of blended learning in their new module would have other benefits for both staff and students. The use of technology would allow students to access material and to participate in the module at a time and in a place that was convenient for them. The module team also thought that the increasing popularity of the internet and social networking sites may make a learning experience which used digital technologies, comfortable and attractive to students. As the students were collaborating online with colleagues in a task, there was the potential that students would develop the skills required to work collaboratively with others.

At the time this research started, the Department of Health (DH) had just published 'A Framework for Technology Enhanced Learning' (DH, 2011), a best practice guideline for commissioners and providers of health and social care education to deliver quality education using technology to enhance learning

'...where there is a clear benefit to patient care.'(p5)

The framework document is based around six principles pertaining to the use of technology in learning. These include that e-learning should be innovative and evidence based, focus on equipping the workforce with skills for safe and effective patient care and be educationally coherent (DH, 2011). There is clearly a need to demonstrate that any e-learning interventions being used in the education of health professionals meet these requirements. The new module ran for the first time in 2008 and has run during each academic year since. Now that this module has run several times, anecdotal feedback from both clinical educators and students indicates that students learning is deeper and can be translated more easily into practice. This research therefore aims to examine whether the participation of undergraduate physiotherapy students in a case based wiki during a cardiorespiratory module can help to develop clinical reasoning skills from the students' perspectives.

For any physiotherapy student, the skill of clinical reasoning develops throughout their course and continues to develop once they are working as a qualified physiotherapist. Christensen (2007) suggested that each student's clinical reasoning may develop in different ways depending upon the learning experiences they encounter, both in the taught course at the university and their clinical placements and how they are able to make use of these experiences to develop their clinical reasoning capability. To understand how the wiki may have influenced the students'

clinical reasoning, it was necessary to consider how the students' clinical reasoning developed over a period of time as they encountered different learning experiences. It was also necessary to consider how the students' clinical reasoning developed from their point of view over this period because of the many things which may influence their clinical reasoning development. These considerations led to the development of the research questions for this thesis.

1.4. Research question

How does the experience of participating in a case based wiki prior to clinical placement contribute to the development of professional practice skill of clinical reasoning from the pre-registration physiotherapy students' perspective?

1.4.1. Research sub-questions

1. What does the pre-registration physiotherapy student understand by clinical reasoning?
2. What is the process of development of clinical reasoning from the pre-registration physiotherapy students' perspective?
3. What contribution, if any, does the case based wiki make to the development of clinical reasoning skills from the pre-registration physiotherapy students' perspective?

1.5. Aims of the investigation

1. To investigate and understand whether, and if so how, participating in a case based wiki prior to clinical placement helps to develop clinical reasoning from the pre-registration physiotherapy students' perspective.
2. To critically assess the implications of using a case based wiki to facilitate the development of clinical reasoning in pre-registration physiotherapy students prior to clinical placement.
3. To explore the use of sociocultural theory as a framework to consider the contribution a case based wiki may make to the development of clinical reasoning skills in pre-registration physiotherapy students.

1.6. How the subsequent chapters contribute to the thesis

Chapter two presents the background to the research and includes consideration of how TEL has developed both nationally and internationally and within the university where this research took place. Consideration is also given to learning theory which underpins e-learning and the development of clinical reasoning in physiotherapy.

Chapter three provides a critical review of the literature related to learning clinical reasoning in physiotherapy and how expert clinical reasoning develops. Literature related to TEL in physiotherapy, the use of wikis in education with a focus on learning experiences of health students and TEL and clinical reasoning is critically reviewed. The chapter finishes by defining the research problem and justifying the need for the research.

Chapter four explains the rationale for the chosen research methods and data analysis, explaining how these fit with the chosen methodology and theoretical perspective of this research in a coherent manner.

Chapter five presents the results with an analysis of the wiki printouts, interviews and focus groups. Firstly a presentation of the students' concept and development of clinical reasoning and how it changed over time is presented, followed by consideration of important themes in their clinical reasoning development. The role of the wiki as a mediator in their clinical reasoning is discussed. An analysis of the wiki printouts is presented to support and integrate with the interview and focus group analysis.

Chapter six provides a synthesis of the findings in relation to the research questions and related literature. The chapter goes on to consider the limitations of the work, the reflexivity of the researcher and the implications of the findings.

Chapter seven presents the conclusions with an emphasis on the original contribution that this research makes to the body of knowledge in this area and includes consideration of implications from this research and areas for further research.

1.7. Situating myself in this study

I could be considered to have been an educator throughout my whole career as a physiotherapist and lecturer. Physiotherapists in practice spend large amounts of their time educating patients about their conditions and how to manage them. Education of other staff and students was also an important part of my role as a clinical physiotherapist. I have been a lecturer for about fifteen years now and during this time, I have been intrigued by how people learn in different ways but I am still surprised how so much importance continues to be placed on the lecturer and reproducing what they say in the student's current view of learning because students can easily access so much information through technology. This has led to my interest in constructivist pedagogies and helping students understand that they can learn in different ways. My areas of specialty as a physiotherapist are cardiorespiratory physiotherapy and exercise and I lead the cardiorespiratory team who work on the module under consideration in this thesis.

The module team decided to change the way the module ran because of our involvement in a problem based learning, pre-registration Master's physiotherapy course, where we provide the cardiorespiratory input. The learning of the students on this course seemed deeper with a stronger link between theory and practice. The module team wanted to try and reproduce this with our undergraduate students on the traditional course and therefore designed and implemented the new TEL module to attempt to achieve this. Anecdotally from our clinical colleagues who supervise our students in practice, we have heard that this may be the case. This became the basis for this piece of research as I started the Doctorate in Education. I wanted to try and find out if this type of constructivist TEL really could improve the link between theory and practice for our students and facilitate the development of their clinical reasoning. The research described in this thesis goes some way towards answering these questions and begins by considering the background to this study in detail in chapter two. A reflexivity section, which considers how this research has impacted my practice is included in chapter six.

2. Chapter Two: Background

This chapter will focus on the background to this research. To set the scene for this piece of research, it will consider: how TEL has developed from a national and international perspective; how the university where this research took place has approached and supported TEL from an institutional level; and how TEL has been used at local level within the university. The chapter will then go on to give a background to the development of clinical reasoning knowledge in physiotherapy and discuss the learning theory underpinning the research. The chapter will explain how the introduction of TEL shifted the students' learning from a traditional behaviourist approach, with which they were familiar, to an unfamiliar approach of constructivism.

2.1. Technology enhanced learning

Over the last twenty years there has been a massive growth in the use of e-learning in higher education. This has been driven by the growth of the internet, globalisation of business and commerce and governments' requirements for workforces that can work flexibly and independently with information technology (Holmes and Gardiner, 2006). During this period there has also been a large number of policy documents produced outlining the possible transformational potential of e-learning (HEFCE, 2005; HEFCE, 2009; Department for Education and Skills (DfES), 2003; DfES, 2005). Whilst this emphasis on TEL has been reflected internationally, for example in the United States of America, the National Education Technology Plan (United States Office of Education, 2010) suggests that new technologies will be involved in the process of transforming education, little has been included about how this may be accomplished. In response to the Government's White Paper 'The future of higher education' (DfES, 2003), the Higher Education Funding Council for England's strategy for e-learning (2005) stated:-

'We are committed to working with partners to embed e-learning in higher education in a full and sustainable way within the next 10 years.' (p3)

Although there has been concentration on building the infrastructure in universities to support e-learning, the challenge still remains to 'embed' e-learning within learning and teaching strategies in institutions to support its use in a learner centred, collaborative pedagogical approach (Browne et al 2008). This view is supported by Moule et al (2010) who carried out a survey to assess the adoption of e-learning in nursing and health science courses within higher education in the United Kingdom (UK) and the factors affecting this. They found that e-learning remained at the periphery of educational development in nursing and health sciences, being used largely to support face to

face teaching and provide information rather than utilising the constructivist pedagogic possibilities of TEL. Al-Shorbaji et al (2015) carried out a systematic review of e-learning for undergraduate health professional education to evaluate its effectiveness. Even though this research took place five years after that of Moule et al (2010), Al-Shorbaji et al (2015) concluded that further research was required '*...to assess the impact of e-learning in the education and training of allied health professionals...*' (pxvii). There is clearly still a need to research TEL in nursing and health science education to establish its value.

The difficulties of harnessing the transformational potential of e-learning have been summarised by the Online Learning Task Force (OLTF) (2011), a body established by HEFCE to consider how UK higher education could develop and maintain a position at the forefront of online learning. Technological change occurs rapidly. Since the research for this thesis started, social networking using providers such as Facebook, Twitter and Instagram has become commonplace. This type of networking could be and is already being exploited pedagogically by universities. For example, the Joint Information Systems Committee's (JISC) e-learning programme (2016) has produced a guide to explain how social networking tools may be implemented within education. The guide contains examples of how different universities have used social networking successfully to support learning (JISC, 2016). However pedagogical development of this type is usually slow in comparison to the rate of technological advances because of the slow rate of skills development and changes within a university's organisation that may be needed to allow these advances (OLTF, 2011).

The recent economic downturn has placed a political constraint on public spending, led to a more market driven approach in higher education and to the disbanding of organisations such as the British Educational Communications and Technology Agency (BECTA) in 2011 (Arthur, 2010). Although BECTA was largely concerned with information technology in schools, aspects of their work such as their report '*Harnessing Technology Review 2009: The role of technology in further education and skills*', which brought together research evidence about technology in the further education and skills sector (BECTA, 2009) and the impact of their work in schools on the information technology skills and expectations of potential university students, were influential in universities. These economic and policy changes could offer an impetus to universities to use technology to develop large scale, collaborative, cost effective TEL courses such as massive open online courses (MOOCs) for example or lead to a fragmentation of research into and innovation in the pedagogy of TEL. Marshall (2010) argues that university culture, such as recognised ways of measuring performance or assessing students and the existing technological capability, imposes barriers to and determines the extent of innovation in pedagogy in institutions.

In 2009, HEFCE published a revised approach to their strategy for e-learning. This document provided a shift of emphasis in their policy to consider how technology can support learning and related processes. They explained how the term 'e-learning' may no longer describe the range of uses of learning technology in universities and wanted '*...to focus on the benefits and the outcomes from using technology to support learning and related processes...Underpinning infrastructures, management practices, architectures and services have an impact on learning, teaching and assessment...*' (HEFCE, 2009, p1). The reasons for this shift in emphasis are possibly related to the economic climate and the emphasis on students as consumers of education but HEFCE also emphasised how BECTA's review (2009) had influenced their approach as well as placing more emphasis on individual universities choosing how they adopted technology (HEFCE, 2009). This shift in policy towards using technology to build management systems in universities could be because of the difficulties associated with fully embedding e-learning in pedagogical practice and highlights the need for further research into the pedagogy of TEL, to show where TEL can be effective.

In the institution where this research was carried out, the seventh objective of the Strategic Plan (2012-2015), was based around digital transformation stating that:-

'All our courses will be supported by innovative and creative use of technology for learning, teaching and research with a focus on the use of mobile technologies, embedded in high quality, university-wide IT systems ...' so that, *'by 2015 the university will win a sector award for excellence in the use of digital technology for learning and teaching...'* (p9)

This objective appears to be based around the pedagogical use of technology as well as the management systems within the University. The details of the University's strategic plan (2012) also emphasise the updating and development of IT skills for academic staff and the delivery of courses using accessible interactive digital resources and technologies. However a review of the plan in 2013 seems to place much more emphasis on the development of IT management systems rather than the creative and innovative use of technology in learning and teaching:-

'A strong central framework of consistent practice and process for core activity and quality assurance, supported by the development of IT systems and processes will be implemented...' (Laing, 2013, p2).

The strategic direction adopted by an institution will be driven by external pressures such as the political and economic climate, student demands and the results of institutional reviews by bodies such as the Quality Assurance Agency. Focus on the strategy which appears to offer the most rewards to the institution will inevitably occur and at this time, this is on the IT management systems of the university. Despite this the 2012-15 strategic plan of the university also emphasises

the importance of improving the research profile of the university and that learning and teaching processes should be underpinned by pedagogic research, thus supporting the research in this thesis.

The Department of Health has also encouraged the use of e-learning in the education of health workers (Moule et al, 2010). It has published reports including plans for how e-learning could be used in lifelong learning (DH, 2001), how technological advances in care should be included in the curriculum, (DH, 2006) and how technology should be used to provide quality education for health professionals (DH, 2011). In their document 'A Framework for Technology Enhanced Learning' (DH, 2011), a best practice guideline for commissioners and providers of health and social care education to deliver quality education using technology to enhance learning, DH have stated that technology should be used

'...where there is a clear benefit to patient care.'(p5)

The framework document is based around six principles pertaining to the use of technology in learning. These include that e-learning should be innovative and evidence based, focus on equipping the workforce with skills for safe and effective patient care and be educationally coherent, (DH, 2011). There is clearly a need to demonstrate that any e-learning interventions being used in the education of health professionals meet these requirements. As the research for this thesis has been carried out with students whose education is being funded by the DH, it is important to consider the effectiveness of TEL with these students.

In their second survey of UK higher education institutions (HEIs) about TEL (Browne et al, 2008), the authors explained the primary drivers for using e-learning in universities as enhancing the quality of teaching and learning activities and student expectations. Students entering higher education now are seasoned users of information technology and expect it to be part of their environment. Oblinger (2003) discussed the different types of students entering higher education today. She referred to those born in or after 1982 as the Millennial Generation. This group make up the majority of students on the module under investigation in this thesis and appear to have learning preferences for teamwork, structure and the use of technology (Raines, 2002) so would seem to be well suited to studying using TEL. The OLTF (2011) reported that students wanted a range of learning options and saw e-learning as one of these, especially as a useful way of managing learning with other commitments and a potential way of reducing the cost of studying, but they did not want the use of e-learning to affect the quality of their learning experience. The students' views about e-learning are clearly in line with those of the DH about technology being

used to provide quality education (DH, 2011). Although students expressed concerns over the ICT skills of some of their lecturers, they also admitted to lacking the skills including research, referencing and critical thinking, to make the best use of the information which they had sourced on the internet (OLTF, 2011).

In universities there had been concentration on building the infrastructure to support e-learning. Browne and Jenkins (2003) carried out their first survey of UK higher education institutions and reported that 86% of respondents had a virtual learning environment (VLE) at that time, largely used as a supplement to face to face teaching, to deposit teaching material and communicate with students for administrative aspects of their course or module. This reflects the experience of the author at this time. The VLE which is powered by Blackboard in the author's institution, had largely been used as an administration system and as a repository of information for students on the BSc (Hons) Physiotherapy course up until the time that the module under investigation was introduced. The discussion board was the only other feature of the VLE which had been used with students on this course with varying degrees of success. The way in which academic staff were using the VLE may suggest a lack of necessary information technology (IT) skills to incorporate e-learning into their practice. Haynes et al (2004) surveyed staff across the University to try and find out the level of IT skills amongst staff. Their survey results were to be used as a basis to develop staff training in IT so that staff in the university had the knowledge and skills to be able to help make judgements about how they could use technology to assist learning. They found that more than half of the staff surveyed in the university did not have the level of IT knowledge and skills that were considered necessary to make these judgements. Laurillard (1993) argues that technology should assist the dialogue between student and lecturer, which she sees as a central part of the higher education process. For this to happen, lecturers need both knowledge and skills in information technology and related pedagogy to make effective use of IT in their teaching.

Singh et al (2005) have argued that there is an inevitability about the use of technology in higher education because it makes communication easier, allows for distance learning and flexibility in learning from the student's point of view. They go on to suggest that the successful implementation of e-learning within an institution requires a strategic approach with careful structuring to avoid chaos. The e-learning strategy adopted by different institutions will vary and some maybe more successful than others. By introducing e-learning strategies, universities are giving more direction about teaching to academics, who may previously have been quite independent in their choice of teaching methods. Wells (2005) interviewed academics from one university who were required to use online teaching by university management so that the

university was seen as flexible, responsive and accessible by the public. The academics felt 'de-skilled' and 're-positioned' by the technology. This supports the findings of Haynes et al (2004) and would suggest that there may not have been much progress in improving or maintaining lecturers' IT skills in step with rapid technological advances. Whilst some academics may possess the necessary IT and pedagogic skills to use e-learning in their teaching, Swann (2010) argues that they also require special skills to facilitate online dialogue which will encourage social construction of understanding and knowledge. These skills need to be developed and are not the same as those used in face to face teaching. For e-learning to be successful the specific facilitation skills that lecturers need are facilitating real time events, moderating online discussions and coaching students.

A rise in the development of local e-learning strategies in an effort to embed e-learning within universities was reported by Browne et al (2008) in their follow up survey to that of 2003. The Academic Board of the University where this research was carried out, made two baseline e-learning recommendations in September 2009 about consistent levels of minimum provision for all courses and modules in relation to the university VLE (UVLE) and the capabilities and skills, both technical and pedagogical, which lecturing staff should have in e-learning. Staff were asked to audit current use of the UVLE, identify and fill existing gaps. Staff development programmes were put in place to help make the best use of the UVLE. As these recommendations were felt necessary, one can infer that there were a number of staff or even Schools across the university who had chosen not to use or engage with the UVLE. This may be because the design of the technology was not user friendly or because there were easier ways of doing things. There is also the possibility that staff chose not to engage with the technology because of the design of the technology that had been imposed by the University upon them. Wells (2005) reported that academics were offended by their university's imposition of an e-learning platform upon them because this had been '*...driven by regulation rather than good pedagogy...*' (p17). In the School where this research was carried out, staff were being encouraged to actively engage with e-learning strategies at this time, both for blended learning experiences on courses based within the university and for the development of distance learning courses.

As well as the difficulties of implementation of local e-learning strategies, there may be further complex reasons why e-learning has not become embedded within academic practice in HEIs. Sharpe et al (2006a) highlighted the importance of engaging teams of staff in developing and implementing e-learning strategies in a university school with protected time and adequate resources. Birch and Burnett (2009) carried out 14 in depth interviews with academics in an

Australian university, both adopters and non-adopters of e-learning, and found that lack of time for lecturers to familiarise themselves with this different way of working, a lack of leadership and strategic direction in e-learning, increased academic workload and lack of support from the institution in terms of time relief were all barriers to the development of e-learning. For e-learning to become embedded in practice and so a normal and familiar experience for students, there clearly needs to be appropriate conditions for change which should include upgrading of the IT skills of academic staff, time, resources and support of the institution, (OLTF, 2011).

Birch and Burnett (2009) found that the e-learning adopters in their group appeared to be intrinsically motivated and had used technology to try and enhance the student learning experience. The concept of a more knowledgeable other who inspired or guided participants through the process of incorporating e-learning into their practice has been utilised in a HEFCE funded two year project, called the ePioneers Initiative (Arici, 2008). The project was undertaken in the School of Education at the University of Nottingham and aimed to move e-learning from a small group of early adopters to an activity which supported all courses and learners. The project was a strategic intervention based on the diffusion conceptualisation theory of Rogers (2003) about the take up of innovation, part of which relies on early adopters of innovation talking to their peers about their own view of the innovation and so decreasing uncertainty about the innovation. By using mentors who were current e-learning innovators and establishing an e-learning community the project appeared to be successful at meeting its aims. This may be because the strategy adopted by the University was a softer 'bottom up' approach rather than a 'top down' requirement. Sensitive management, investment and support is vital to allow academic staff to engage with technology and meet the expectations of students (OLTF, 2011) but there also needs to be a deeper understanding of the possibilities offered by TEL in specific learning situations to exploit its potential. This piece of research should add to the knowledge in this field.

In October 2013, Health Education England (HEE) launched a TEL programme in conjunction with the Higher Education Academy. They produced a brochure to support this initiative (HEE, 2013) for wide distribution within the NHS and associated universities, encouraging those using e-learning in the education of healthcare professionals to come forward and share their ideas with others. Their aim was to share good practice, innovation and avoid duplication in TEL. This aim is shared by the OLTF (2011) who stated that universities should build on existing open educational resource initiatives and use examples of TEL which have already been shown to work. If these types of collaboration are successful, any further developments in TEL that are shown to work

may have a large impact on the education of health professionals and the research related to how students experience this type of learning.

2.2. Clinical reasoning

This section will focus on the development of knowledge and theory in clinical reasoning in physiotherapy and consider the cognitive skills required to carry out clinical reasoning in practice. Clinical reasoning is a vital skill for effective physiotherapy practice and can be defined as:-

'...the sum of the thinking and decision-making processes associated with clinical practice.' (Higgs and Jones, 2008; p4)

This is a very simple definition of a complex activity and to understand clinical reasoning, it is necessary to consider the complexity of the activity and how it lies at the heart of professional practice. The complexity of clinical reasoning encompasses the professional attributes of autonomy, responsibility and accountability and being able to make decisions in conditions of uncertainty. This means that to be able to clinically reason successfully physiotherapy students need to learn to juggle many variables such as competing healthcare needs and the interests of different stakeholders to make ethical decisions informed by practice knowledge within social expectations (Higgs and Jones, 2008). Not only do they need to do this as a practitioner in their own right but they also need to learn to clinically reason and make decisions collaboratively. Clinical reasoning is at the heart of clinical practice and as such the development of clinical reasoning should be a priority for pre-registration physiotherapy programmes but recent research has illustrated a large variability in clinical reasoning learning experiences in both academic and clinical settings (Christensen et al, 2008). Many of the physiotherapy education programmes included in this study actually devolved the learning of clinical reasoning to the students.

2.2.1. Clinical reasoning in physiotherapy

Although there is no single standard model that can represent clinical reasoning for a physiotherapist in every clinical situation, there is a growing body of knowledge and understanding about clinical reasoning in physiotherapy. Jones et al (2008) state that to understand the clinical reasoning of a physiotherapist and how they manage a patient, it is necessary to consider the thinking processes of the therapist, their patient and the shared decision making between them both. Current physiotherapy practice recognises a model of clinical reasoning described by Edwards et al (2004) that is characterised by different clinical reasoning strategies and their interplay within the different research paradigms (Figure 2.1).

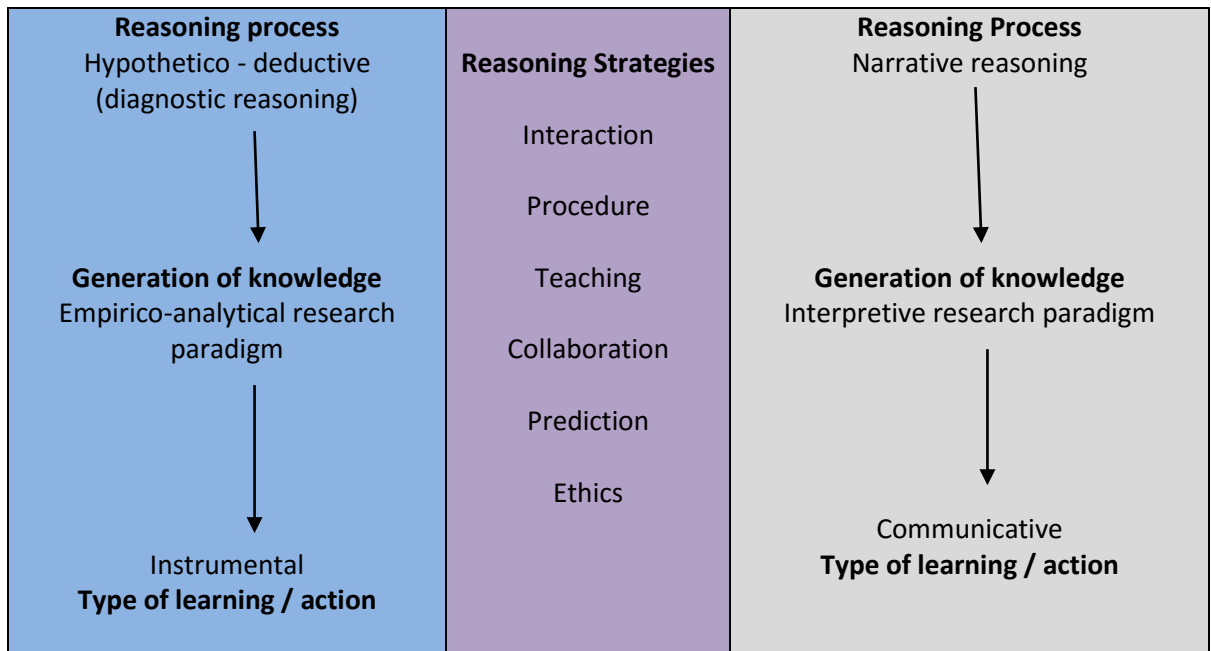


Figure 2.1: 'Summary of the relationship between knowledge and reasoning paradigms with clinical reasoning strategies ' (adapted from Edwards et al, 2004, p323)

The framework was based upon interviews and observation of six expert physiotherapists in practice, two from each specialty of neurology, musculoskeletal and community physiotherapy and six other expert physiotherapists from these specialties. The analysis identified clinical reasoning strategies, then how these strategies were combined based on cues provided by the patient in the treatment session and finally considered '*...the interplay of reasoning strategies in different paradigms of knowledge...*' (Edwards et al, 2004, p322). They called this type of reasoning dialectic reasoning, realising that physiotherapists need to use their knowledge and clinical decision making to make diagnoses whilst also critically reflecting upon how the patient's beliefs and assumptions may impact on their problem and, at the same time, trying to communicate this with the patient. This framework is a good reflection of physiotherapy clinical reasoning because the physiotherapists in the study used a similar range of clinical reasoning strategies to those which had already been identified in the literature (Payton, 1985; Mattingly, 1991; Rivett and Higgs, 1997; Edwards et al, 1998; Jensen et al, 2000). It also illustrates that clinical reasoning strategies used in physiotherapy and the thinking skills required to support this are complex processes and highlights the challenge associated with helping physiotherapy students learn how to reason clinically. There is a strong emphasis on understanding the epistemology of knowledge generation, professional practice knowledge, and communication in this model. The pedagogical tools associated with learning clinical reasoning should reflect these areas. By using the wiki in our module, we thought the students may generate new knowledge,

communicate with each other and gain some practice knowledge from the patient cases themselves and the feedback of tutors, who were all qualified physiotherapists.

The clinical reasoning strategies illustrated in this model (Edwards et al, 2004) have been identified in the research or proposed theoretically in the health professions literature and warrant further consideration to understand how they make up this model. Jones et al (2008) state that clinical reasoning strategies can be placed in two categories, those concerned with diagnosis; diagnostic and narrative reasoning which are illustrated at the sides of the model, and those concerned with management; interactive, procedural, collaborative, predictive, ethical and reasoning about teaching, which are illustrated in the centre of the model (Figure 2.1).

The research into clinical reasoning in physiotherapy has reflected that of medicine with studies initially focussing on the examination or the assessment of the patient and formulation of a diagnosis rather than the treatment process (Payton, 1985; Rivett and Higgs, 1997; King and Bithell, 1998). More recently, studies about clinical reasoning have considered clinical reasoning during physiotherapy treatment of a patient rather than just assessment and the formation of a diagnosis (Jensen et al 1992; Jensen et al 2000; Doody and McAteer, 2002). As therapists tend to spend much more time with a patient treating them compared to a Doctor who normally diagnoses a patient and then very often refers them on to someone else for treatment, clinical reasoning and decision making become iterative processes which are linked to treatment and how the patient responds to treatment. Mattingly (1991) carried out a large study into the clinical reasoning of American occupational therapists and recognised that patients' clinical problems may only manifest themselves during treatment, prompting a shift of emphasis from diagnosis to treatment. Further research (Mattingly and Fleming, 1994) described three types of reasoning: procedural, interactive and conditional. Procedural reasoning is based on the hypothetico-deductive approach of diagnosis and treatment. Interactive reasoning is based on face to face interaction between therapist and patient and allows the therapist to know the patient, their feelings about treatment and the context of their problem (Fleming, 1991). Conditional reasoning is an integrative process where the therapist reflects upon the clinical encounter from both procedural and interactive views (Jensen et al, 2000). In light of Mattingly and Fleming's work in the early 1990's, the focus on diagnosis led practice started to shift to also consider the patient themselves - how the patient experienced their illness or disability (Edwards et al, 2004). This started to move research and knowledge about clinical reasoning into constructivist or interpretivist paradigms recognising that the experience of illness, pain or disability may be different for everyone. Rather than just being a diagnostic process, the interactive part of clinical

reasoning became recognised as research started to focus on the interaction involved in the clinical reasoning process (Higgs and Jones, 2008). Other types of reasoning such as multidisciplinary reasoning (Loftus, 2006), ethical reasoning, collaborative reasoning and narrative reasoning (Edwards et al, 1998) became recognised. However, both diagnostic reasoning and interactive reasoning are important in physiotherapy encounters with patients. The physiotherapist needs to understand what is wrong with the patient in terms of their condition and also how this is affecting their life. Contemporary physiotherapy practice largely rests on a biopsychosocial understanding of disability and health (Borrell-Carrio et al, 2004). This means that full consideration should be given to environmental and psychosocial factors that may impact the patient's physical health when they are assessed and treated by a physiotherapist. If a physiotherapist's clinical reasoning reflects the biopsychosocial model, the physiotherapist should treat the patient in a holistic and collaborative manner (Edwards and Jones, 1995).

2.2.2. Expert and novice clinical reasoning

Jensen et al (2000) explained that learning how experts think and perform in clinical practice is vital to the development of the profession and to guide how to structure and what to include in physiotherapy education programmes, at both pre- and post-registration level. Jensen's research (Jensen et al, 1990; Jensen et al, 1992; Jensen et al, 2000) has focussed on the differences between expert and novice practice in physiotherapy. Their work was based initially on studies on expertise in the medical field. These had identified that when only hypothetico-deductive reasoning strategies were used, whether clinical problem solving was successful or not could not be distinguished between those practitioners with varying levels of expertise. What seemed to be important was how expert practitioners recalled knowledge which was directly relevant and meaningful to the case (Schmidt et al, 1990).

The older models of clinical reasoning such as hypothetico-deductive reasoning (Elstein et al, 1978) and forward reasoning; backward reasoning (Patel and Groen, 1986) are concerned with forming a diagnosis and were initially developed by medical researchers. They rely on inductive or deductive reasoning to generate hypotheses using knowledge and clinical data that has been elicited from the patient during examination or from the results of investigations and tests that are carried out. These hypotheses can be tested in the clinical decisions which are taken, then modified or discarded if necessary, interspersed with further iterative information gathering (Kassirer, 1995). They are classified according to the reasoning strategy or the way that thoughts are processed. Schmidt et al (1990) and Boshuizen and Schmidt (1992) recognised that a large amount of information needed to be integrated in the clinical reasoning process and called this

knowledge reasoning integration. They also recognised that expert practitioners were able to do this effectively by recognising patterns in their patients' presentations which can speed up the reasoning process and make it more efficient by using similarities of the present case to those treated previously (Groen and Patel, 1985). Novice practitioners tend to rely on hypothetico-deductive reasoning or backward reasoning, also known as deduction (Elstein et al, 1990). Elstein et al (1990) also reported that experts can revert back to these reasoning strategies in difficult or problematic cases. Clinical reasoning of this type is also referred to as diagnostic reasoning and is based in the positivist paradigm (Edwards et al, 2004), where practitioners may be looking for a degree of certainty about their decisions and the outcomes of these in challenging situations. It would therefore seem sensible to use 'simple and straightforward' cases or scenarios so that students can start to learn about clinical reasoning in situations with less uncertainty. This is what we tried to do in the design of our module, initially using patient cases whose conditions were stable and chronic and where there was plenty of research and practice knowledge about them and their conditions.

The traditional curriculum in pre-registration physiotherapy courses usually involves pre-clinical time in the university focussing on basic sciences and treatment skills followed by periods of clinical placement where clinical reasoning is often introduced. The transition into clinical practice can be difficult where there is little conceptual linkage between individual subjects (Schmidt et al, 1990). This is also the case for medical students and prompted some seminal research by Boshuizen and Schmidt (1992) which investigated the differences between how novices, intermediates and experts in the medical field arrived at a diagnosis using clinical reasoning. They asked a total of twenty novice, intermediate and expert medical staff to think aloud about how they would go about diagnosing a patient presented to them as a paper case. The novice group consisted of second year medical students, the intermediate group of fourth and fifth year medical students and the experts were family physicians with four years' experience. They found that clinical reasoning of novices is characterised by lines of linked small steps based on detailed thought about the knowledge they had gained in the pre-clinical part of the course. This is a very demanding way of thinking. As the novice practises clinical reasoning they develop a knowledge network containing clusters of information which are links between the concepts. Boshuizen and Schmidt (1992) called this 'knowledge encapsulation', a process which allows the detailed consideration of basic scientific knowledge and step by step reasoning to be bypassed. As the Doctor becomes expert in clinical reasoning, their knowledge network is reorganised again into 'illness scripts' which are used as a whole and contain three components concerned with the conditions under which a disease occurs; the pathophysiology of the disease and the signs and

symptoms of a disease. When a patient sees a Doctor, they activate one or several illness scripts until they find the one which matches the patient's presentation. This is a form of pattern recognition which was originally identified in the medical field by (Groen and Patel, 1985). Boshuizen and Schmidt (1992) theorised that experience in clinical practice was the key to this change in thinking pattern. Once an individual has been exposed to clinical practice for long periods, their detailed biomedical knowledge shifts to encapsulated clinical knowledge in the form of illness scripts. The detailed biomedical knowledge is only retrieved for use in complex clinical cases (Elstein et al, 1990).

Early physiotherapy clinical reasoning studies also focussed on the hypothetico-deductive model of reasoning and the clinical reasoning of experts. Payton (1985) researched the clinical reasoning of expert physiotherapists comparing his results to those of medical hypothetico-deductive studies (Elstein et al, 1978 and Barrows et al, 1982) and concluded that the reasoning strategies of both professions was very similar. He suggested that physiotherapy curricula should use problem based learning, a model for teaching clinical reasoning which had been developed by Barrows and Tamblyn (1980) for educating medical students. Boshuizen and Schmidt's research (1992) suggests that students need to practise thinking in a case-based manner to make the connections between different subject areas in a course, to allow the students to develop clinical reasoning skills. Case-based learning contextualises the learning and organises information in a similar manner to how it will be used on clinical placement (McKenzie, 2000). As the philosophy of our physiotherapy course is traditional in nature as opposed to a constructivist problem based learning course, case based learning in our module is a compromise between the two. The use of case-based learning in our module and the patient cases we have chosen are typical of those that a physiotherapy student will encounter on clinical placement to try and help develop the knowledge networks the students will need for practice.

Jensen et al (2000) explored the nature of expert practice in physiotherapy using a case study research design with a grounded theory approach. Their twelve participants were peer designated expert physiotherapists in four areas of practice (older people, neurology, orthopaedics and paediatrics). Their data was obtained through observation, interviews, review of patient notes and structured tasks such as sorting items on participants' curriculum vitae to show those which had produced the most professional growth. Data analysis produced a theoretical model of expert practice in physiotherapy with four key dimensions; a multidimensional, patient centred knowledge base which continues to evolve through reflection, a clinical reasoning process which is based in collaboration with the patient, a focus on movement assessment linked to patient

function and consistent virtues of caring for and commitment to patients (Jensen et al, 2000). This research highlights how expert clinicians use their patient as a key source of knowledge and place more focus on knowledge learnt from patients rather than traditional academic knowledge such as anatomy or physiology and how they continue to expand their knowledge by critically evaluating and reflecting upon their practice. The research of both Boshuizen and Schmidt (1992) and Jensen et al (2000) illustrates the importance of knowledge and how that knowledge is organised as central to clinical reasoning and physiotherapy practice. Experts seem to use knowledge more effectively to deal with clinical problems.

Eraut (2000) has also discussed different types of knowledge that are necessary to undertake professional work. These are 'codified knowledge', the type of knowledge which may be considered as a professional body of knowledge used in educational courses to teach students about the profession and 'personal knowledge', the cognitive skills that allow a person to think and perform in a situation. This kind of knowledge can be explicit or tacit. He also explains that it is difficult and may be impossible to fully describe tacit knowledge (Eraut, 2000). Eraut (2000) is of the opinion that the importance of tacit knowledge is underemphasised in the education of professionals. He refers to the acquisition of tacit knowledge as non-formal learning which is context specific, so a physiotherapy student must undertake clinical experience to gain tacit professional knowledge. This kind of knowledge is therefore an important part of clinical reasoning, linking theory and practice. If a multidimensional knowledge linked to the patient is a facet of expert practice (Jensen et al, 2000), clinical experience is a necessity to fully develop this kind of knowledge. Jensen et al (2000) also illustrated in her research how experts continue to learn from experience using metacognitive strategies such as reflection on their practice to evaluate what worked and what did not. This highlights the importance of including critical thinking skills such as reflection in pre-registration health professional courses.

2.2.3. The link between critical thinking skills and clinical reasoning

Huhn et al (2013) stated that '*Clinical reasoning can be conceptualised as critical thinking within a specific domain...*' (p26). However, to learn how to clinically reason effectively, a physiotherapy student needs to be able to carry out the process of clinical reasoning and then process the experience of reasoning to learn from it. The following section will consider the link between thinking and learning skills and clinical reasoning and how these skills could be developed by the wiki pedagogy. Solomon and Baptiste (2005) and Christensen et al (2008) have called for physiotherapy pre-registration education which allows not only development of specific professional and technical skills but also generic thinking and learning skills, such as problem

solving, self-direction in learning, reflective and dialectical thinking. Christensen et al (2008) have acknowledged that there are many dimensions and facets to clinical reasoning but state that the four most important are reflective thinking, critical thinking, dialectical thinking and complexity thinking.

Two types of reflective thinking related to practice have been described by Schön (1987), 'reflection on action' and 'reflection in action'. The first of these is a process that allows thinking back on experiences and their outcomes, to organise thoughts coherently and plan for future action (Forneris, 2004). The second is a rapid process that happens during an action and modifies the action without interruption of that action (Schön, 1987). Eraut (1994) has argued that 'reflection in action' is not a reflective process, merely a heightened self awareness or metacognitive process because of the speed and superficiality with which it happens. Reflection on practice is highlighted as central to the evolution of expert professional knowledge (Jensen et al, 2000; Resnik and Jensen, 2003). Both Terry and Higgs (1993) and Jensen et al (2008) emphasise the importance that should be placed on encouraging students to reflect on their learning and allowing time for this in their course but this is sometimes difficult in a traditional course where the emphasis is on teaching large amounts of knowledge, which is time consuming. Using an asynchronous learning process such as the wiki in our module allows more time for reflection and may help the student develop a better understanding of how to reflect on their learning.

Critical thinking has been defined by Scriven and Paul (1987, p1) as '*...the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action*'. Christensen et al (2008) linked this definition to collaborative clinical reasoning in practice, highlighting the importance of the context in which the thinking takes place and the dialogue used to evaluate different perspectives as well as how past learning and experience may inform the present context. To learn about clinical reasoning, physiotherapy students need to think critically about their thinking. Using case based learning with the wiki allows the students to focus on a particular patient at a particular time in their case, to develop a relevant treatment for that patient and to think about and discuss different treatment options with other members of their group. The students were asked to think dialectically in the wiki environment by focussing on both the patient's story or circumstances (interpretive thinking), their knowledge in relation to the patient's diagnosis and the scientific evidence (empirico-analytical thinking) that was available to support their chosen treatment.

Dialectical thinking has been described as an advanced cognitive skill which allows people to cope with the contradictions and complexity of life, (Merriam and Cafferella, 1999). In the context of clinical reasoning dialectical reasoning has been described as the type of reasoning undertaken by experts (Edwards and Jones, 2007). The clinical reasoning model developed by Edwards et al (2004) places emphasis upon the two types of knowledge, empirico- analytic and interpretive, which bring together diagnostic and narrative reasoning to treat the patient holistically. Using case based learning in the wiki highlights the patient's story and how this relates to treatment. Asking students to base their chosen treatment on evidence which supports it for the particular case may start to promote dialectical thinking as the patient's world and the biomedical aspects of their case are brought together. Christensen et al (2008) state that dialectical thinking is an important component of complexity thinking.

Complexity thinking reflects how practising physiotherapy means dealing with several complex adaptive systems at once, such as the ever changing healthcare system, the patient and their carers or family, the healthcare team within the clinical environment and the physiological systems of the patient. Pesut (2004) has likened this to weaving many threads together with the resulting fabric representing the care that a health professional provides for the patient. Schön (1987) has described a complex environment such as that of health care practice as '*...the swampy lowland*' where '*messy, confusing problems defy technical solution...*' (p3). This situation can be difficult to replicate in the taught part of a physiotherapy course and although the wiki cases focussed on a moment in time in a patient's presentation, the collaborative nature of the wiki and the shift to case-based learning for our students added layers of complexity to their learning environment. For some students, the shift of learning pedagogy in the wiki may have felt like entering a 'swampy lowland'.

The research related to learning clinical reasoning will be considered in chapter three.

2.3. Learning and learning theory

A student's learning experience can be changed dramatically by shifting the emphasis of the underpinning learning theory for a course or module. This can happen when new pedagogical tools, for example e-learning, are introduced. It is recognised that the theories of behaviourism, cognitivism and socio-constructivism may all underpin e-learning in certain contexts (Holmes and Gardner, 2006). In a traditional course, students are taught content and are examined to assess whether they have learned the content so that they may progress to the next level. This kind of course is supported by a behaviourist approach to learning (Merriam and Caffarella, 1999) and

would have been a familiar experience for the students in this research. The introduction of e-learning within this module, moved the emphasis to a more constructivist approach to learning, and raised the possibility of shifting the students' learning experience fundamentally. Some consideration therefore needs to be given to the learning theory underpinning the module in terms of the kind of learning that the module tutors hoped the new module would achieve.

One of the aims of the introduction of the e-learning into the module was to encourage a deeper approach to learning. Marton and Saljö (1976) were some of the first researchers to question whether the outcomes of learning could just be described in quantitative terms. In this seminal piece of research they asked a group of students to read a piece of text which they would be asked about later. They found two very different types of students; one group memorised facts. The second tried to understand the meaning of the piece. Saljö (1979) further explored a group of adult students' understanding of learning. He asked the group how they would define learning and identified five main categories, hierarchical in nature, into which the learners' responses fell. The first three offered a fairly simplistic view of learning, for example acquiring information and knowledge, and almost implied that learning is something that is 'done' to the learner. It could be argued that these are supported by a behaviourist approach as in our traditional course, leading to a more short term, superficial approach to learning. Students who understand learning as making sense of, abstracting meaning, or interpreting as in the fourth and fifth categories (Saljö, 1979) may have a much deeper approach to learning.

More recently Ramsden (1992) has described how students will choose the learning approach that they take to a task depending upon their perception of the task. As second year university students, the students within this research could be considered adult learners and based on the principles of andragogy (Knowles, 1984), the module team assumed that the introduction of case based, e-learning which required the students to use information to make meaning in a relevant context would lead to a deeper approach to learning. This is very much dependent on each individual learner, what they think they are learning, how they approach learning and how these factors are related to their prior experiences, expectations and perceptions of learning. The pedagogical approach, whether face to face or online, may be irrelevant if students do not understand something about how they learn, what they are expected to learn and how a specific task may help them to learn. Ellis et al (2007) have demonstrated support for this in a piece of research in which they investigated social work students' learning using face to face and online discussions. Forty eight volunteers were recruited to complete three well validated questionnaires each. These were used to try and identify students' approaches to learning and what they thought

they were learning in the face to face and online discussions. These factors were significantly related to their levels of achievement in the module. Those with a clearer understanding of how they learnt from face to face and online discussions and their approach to learning had a higher level of achievement. The sample size in this study is too small to demonstrate conclusive relationships between these factors but indicates a trend which warrants further investigation.

The introduction of e-learning moved the emphasis of the learning approach within our module towards constructivism. Constructivist learning theory emphasises meaning making or the active process of building knowledge rather than memorising and understanding knowledge (Somekh and Lewin, 2005). This approach has been a strong influence on education, particularly in the field of information technology since the 1990s (Woo and Reeves, 2007) and is based on two main orientations to learning, the cognitive and the social. The cognitive orientation to learning or cognitive constructivism has been influenced by the work of Piaget, who believed that a change in cognition occurs through a process of assimilating what is already known and accommodating or adjusting to what is now known whilst coming to a point of equilibration or balance between the two. He regarded the learner as an isolated individual who develops within himself and the environment in a step wise progression (Merriam and Caffarella, 1999). More relevant to the learning experience in this module is Vygotsky's theory (1978), which is based on culture, language and social interaction and how these impact on learning

Vygotsky's theory is defined as a social learning theory (Smith, 1999; Wenger, 1998) which allows for a 'zone of proximal development' (Vygotsky, 1978) to bridge the gap between the historical state of an activity and the developmental stage of the person in relation to the activity. If the learner receives help with an activity, that they could not perform themselves from a more knowledgeable other, they should then be able to grasp and perform the activity, which they were unable to do alone (Wenger, 1998). Vygotsky's theory goes on to describe how this new activity becomes 'appropriated' and 'internalised' and then the learner goes on to be able to actively use what they have learned and expand and develop it further (Liu and Matthews, 2005; Bakhurst, 2007). Vygotsky asserted that all cognitive functions begin in social interactions (Woo and Reeves, 2007) and that the social and cultural contexts were interconnected with the individual to allow appropriation and internalisation of new knowledge. This process of learning may be mediated by language, an artefact, a computer or something else (Vygotsky, 1986). The module design would allow learners access to help from both their peers and tutors, who may be considered more knowledgeable others. Social learning theory allows sharing, discussing, explaining and negotiating meaning with other people whose own life experiences will affect their

individual views to construct knowledge and meaning. Learning takes account of the social context in which the-learning is occurring and the relationships between the people involved in the learning as well as the environment (Wenger, 1998). Vygotsky's view of learning can be summed up in the following quote:-

'The student educates himself... For present day education it is not so important to teach a certain quantity of knowledge as it is to inculcate the ability to acquire such knowledge and to make use of it... Where he [the teacher] acts like a simple pump, filling up students with knowledge, he can be replaced with no trouble at all, by a textbook, by a dictionary, by a map, by a nature walk... Where he is simply setting forth ready prepared bits and pieces of knowledge, there he has ceased to be a teacher.' (Vygotsky, 1997, p339)

He sees the skill of the teacher or the more knowledgeable other as encouraging the student to learn how to find and use information and carry out a critical interrogation of whatever they are learning (Bakhurst, 2007). This model of learning very closely fits the case-based, e-learning model in our module.

The e-learning component of the new module would also encourage small groups of students to come together virtually or face to face in a learning community or community of practice, to develop treatment grids for the patients described in the cases upon which the module is based. For this approach to be successful, the learners required a good understanding of how the task would help them to learn. The concept of groups of people coming together in different social situations, for example the workplace or education, has been described as communities of practice by Lave and Wenger (1991). Their early work was based on organic communities of practice and how they function to produce informal learning. The term community of practice is now used to describe situations where a top down model has been used to manufacture a community of practice, as in our module design. The educator's role has been described as scaffolding the students' learning by establishing communities in which participation and conversation can occur (Smith, 1999). The learning process does not just involve the activity which has brought the students together but also includes how the students participate in the social community and how they construct their identity in relation to the community (Wenger, 1998). If students are unaccustomed to the idea of learning being active participation in a community where they can share and discuss ideas, learn from each other and the tutor, the experience of participating in this module may be a difficult one. They may feel that they have lost control of their learning and choose not to participate in the community. Lea (2005) argues that much could be learned from studying students who participate peripherally in online-learning

communities. Students could be making this decision to maintain some control of their learning and their sense of identity in relation to the learning process.

For our students the kind of community of practice they find themselves in will be different at different times and they will be in several different communities of practice at any one time. Clinical education is an important aspect of their professional training and it is in this situation that Lave and Wenger's (1991) original description of a community of practice may fit best. The social aspect of learning is highlighted by Roskell and Cross (2000). Their research highlighted senior cardiorespiratory physiotherapists' and nurses' views that students were not well prepared for respiratory clinical placement by the university. The clinicians' views about lack of preparedness for clinical placement may give rise to a negative perception of the specialty for students especially if these views are transmitted to the students on placement, who in turn pass them on to other students who have yet to do their cardiorespiratory placement. Roskell and Cross (2003) subsequently carried out a national survey of student perceptions of cardiorespiratory physiotherapy. Their survey had a good response rate (73%) and the sample represented the views of students at all the institutions in the UK where physiotherapy was available. The findings revealed an overall positive view of the value of cardiorespiratory physiotherapy amongst students. However there was some indication that students may have felt less positive about this area of practice because of a lack of confidence in their skills and the negative attitudes of their peers and others. This supports the importance of considering social influences in learning.

From this short discussion of learning theory, it can be seen that several different theories may be important in relation to this research, however the wiki used in this module is considered a kind of social software and as such theories of Vygotsky and communities of practice seem to hold the most importance here. The core concepts of Vygotsky are also central to the data analysis in this research and will be considered further in chapter four.

3. Chapter Three: Literature Review

This chapter will review literature related to how allied health professionals learn clinical reasoning as student therapists. Consideration will be given to research relating to TEL in physiotherapy education and research related to the use of wikis in education. The chapter will end with a section on research related to TEL and clinical reasoning and a justification for the research question based on the literature review.

3.1. Developing clinical reasoning capability

Research into how physiotherapy students develop their clinical reasoning is relatively limited. Christensen (2007) carried out one of the first major studies into this area to explore how physical therapy students, nearing the end of their undergraduate studies, in four institutions in California developed their clinical reasoning. She used focus groups and individual interviews and previously published literature to construct texts, which she interpreted using a hermeneutic approach. One of the main outcomes of her research was the identification of the concept of clinical reasoning capability (Christensen et al, 2008). She explained that '*...capable clinical reasoners demonstrated sound thinking and learning skills...*' (Christensen et al, 2008, p103), skills congruent with those identified in studies examining the clinical reasoning of expert physiotherapists (Jensen et al, 1999; Jensen et al, 2000; Edwards et al 2004). These include the ability to integrate and apply thinking and learning skills effectively to make sense of, generate knowledge and learn collaboratively from clinical experiences (Cruz et al, 2012). In the students that Christensen (2007) studied, these dimensions of clinical reasoning capability were often poorly developed or severely lacking in the participants' thoughts and concepts about clinical reasoning. Christensen (2007) concluded that, as her participants made little connection between thinking and learning skills and clinical reasoning, the link between these skills and their relationship to clinical reasoning was not clearly made in their pre-registration physiotherapy education. Christensen et al (2008) have also commented that because the link between thinking and learning skills and clinical reasoning is not clearly made and the importance of clinical reasoning in relation to professional practice is not emphasised, learning clinical reasoning is often devolved to the students themselves. The research by Christensen (2007) was partly driven by changes to the education of physiotherapists in the USA where the American Physical Therapy Association (APTA) had stated that physical therapy would be provided by Doctors of Physical Therapy by 2020 (APTA, 2000). As physical therapists are now required to hold masters level or doctoral level qualifications for entry into practice, this has placed increased emphasis on cognitive skills and the development of clinical reasoning skills (Commission on Accreditation in Physical Therapy Education (CAPTE), 2011) in

physical therapy programmes in the USA, although it is acknowledged that changing the entry level of a profession will not automatically improve clinical reasoning.

To try and show the value of educating entry level physiotherapists to Doctoral or Master's level, much emphasis is currently being placed on trying to find an objective way to track change in critical thinking skills through physiotherapists' education. Huhn et al (2013) stated that clinical reasoning capability can be difficult to measure objectively. Brudvig et al (2013) carried out a systematic review to determine whether critical thinking skills in health professional students changed as a result of their education and concluded that evidence to support this was scarce. They called for more well designed, adequately powered studies in this field and suggested that physiotherapy specific critical thinking tools should be developed to measure the acquisition of critical thinking through the education of physiotherapy students. Although this kind of quantitative evidence (Brudvig et al, 2013) may be important for institutions to show the value of educating physiotherapists to Doctoral level, for example to funding bodies and others who may question the value of providing physiotherapy education to these higher levels, it could be argued that exploration of how physiotherapy students develop these critical thinking skills is more important to model effective pedagogy for developing clinical reasoning. Using physiotherapy specific critical thinking tools such as these are potentially fraught with difficulty. Students on pre-registration physiotherapy courses are exposed to many different influences which may affect their critical thinking ability at any one time and so it would be very difficult to design a tool which can measure the influence of the introduction of one new learning situation on critical thinking within a physiotherapy course. The tool may lack the sensitivity required to show small amounts of change in critical thinking skills related to one module for example. This would depend on the situation in which the tool was developed, the type of students on a course or the nature of curriculum design and whether these variables affect the validity of using the tool in a different situation. Exploration of how the influence of a new learning experience, in this situation the wiki, affects the development of critical thinking skills from the students' point of view is vital to inform pedagogical development. The use of e-learning to help develop clinical reasoning skills may offer an effective alternative to develop critical thinking skills and this research will investigate whether this is the case and provide some more information about how physiotherapy specific thinking skills develop.

3.1.1. Research into the clinical reasoning of student physiotherapists

Cruz et al (2012) explored the understanding of final year Portuguese physiotherapy students about clinical reasoning and its relationship to the musculoskeletal area of practice in their

curriculum. He used a hermeneutic approach to interpret data collected from focus groups with the students and found several themes which included an instrumental process, to allow the student to make a diagnosis upon which to base treatment, a clinician centred process, a thinking process which belonged to the clinician and a knowledge dependent process. These findings highlight the difficulty that students and novice physiotherapists have integrating the patients' goals, needs, lifestyle and environment into their reasoning and why they tend to focus more on symptoms and impairments. The findings of Cruz et al (2012) are similar to those of Hendrick et al (2009) who explored student physiotherapists' conceptualisations of clinical reasoning in musculoskeletal practice. Their study is of particular interest because their participants were at different stages of their undergraduate education, some from each year of the course and the research for this thesis followed students as their clinical reasoning developed. Their findings revealed a continuum of clinical reasoning from less to more sophisticated and complex. The less sophisticated conceptions focussed on making a diagnosis and using knowledge to justify treatment. The last conception called problem solving and pattern building, which was only evident in a third of final year students, was the only one to show metacognitive processes such as reflection being used and also put more focus on the patient. Hendrick et al's (2009) participants carried out their clinical practice in their final year which may have accounted for these results. Hendrick et al (2009) suggested that their dimensions of clinical reasoning could be used as a basis for teaching, learning and assessment strategies for clinical reasoning development. The use of a case based wiki with our students may affect how their clinical reasoning develops in comparison to the students in Hendrick's study.

Other research into how students and novices carry out clinical reasoning has shown that physiotherapy students and inexperienced physiotherapists tend to be therapist-centred and focussed on the procedural aspects of clinical reasoning (Jensen et al, 2000; Smith et al, 2007). It could be argued that this is also a product of education which focuses on qualification rather than understanding but this research was not concerned with how the physiotherapists were educated, rather the amount of experience they had had in practice in a particular specialty and warrants further consideration in relation to the practical experience the students included in this research underwent. Smith et al (2007) carried out their research specifically with physiotherapists who worked in acute respiratory care. They recruited fourteen physiotherapists who were currently working in this area and classified them into three categories according to the level of their experience in the acute respiratory field. Data were collected by observation of the physiotherapists at work and follow up interview, both focussed upon their clinical decision making. The researchers found that three types of factors influenced the participants' clinical

decision making. These were related to the nature of the decision itself; a more complex decision based on uncertainty required a more complex reasoning process, the context in which a decision occurred, for example the organisational or socio-professional constraints, which may affect decision making and the physiotherapist themselves, their level of experience, frame of reference and decision making capability. High level experience resulted in a high level of confidence and self-efficacy in decision making, less reliance on other physiotherapists or other health professionals in decision making and more willingness to take risks to achieve the optimal outcome for the patient. Less experienced physiotherapists needed more support in decision making, were less likely to take risks in case of an adverse event and to have limited or fixed ways of practice. Smith et al (2007) came to some interesting conclusions which included that factors influencing clinical reasoning are interwoven into the decisions that physiotherapists make in acute respiratory care. Student physiotherapists have to learn to negotiate and manage multiple factors which impact on patient outcome and so learning to clinically reason should include negotiating and managing these multiple factors as they learn underpinning knowledge and treatment options for this type of patient. Although our module was based on fixed patient cases, by using the wiki students were learning to navigate several factors, such as managing collaborative working and articulating clinical decisions, whilst learning underpinning knowledge and skills, which all increased the complexity of the decision they had to make about treatment. The wiki may thus enhance clinical reasoning ability and warrants further investigation because of the link between complexity thinking, critical thinking skills and clinical reasoning (Christensen et al, 2008).

Another factor influencing decision making in Smith et al's study (2007) was high workload. The research of Masley et al (2011) supported this finding. They carried out a qualitative study exploring physiotherapist practice in the acute care setting and concluded that clinical reasoning in this setting occurred in a '*...crowded, complex, fast paced environment and resulted in rapid decision making...*'(p906). Where workload is high there is not time to analyse problems, reflect on actions or consult others and there is more potential for errors to occur (Kennedy, 2004). Eraut (2004) has suggested that where there is limited time for decision making, professionals tend to adopt ways of working that rely on routines learned from the past, rather than using meta-cognitive skills to come to an optimal decision for each patient. This can have an important effect on future ways of working of student physiotherapists if high workload is an issue (Smith et al, 2007). It is therefore vital that student physiotherapists also have the opportunity to practice their decision making, and the module design using the wiki allowed students to do this. The fact that the wiki allowed practice in decision making also warrants further investigation.

Apart from the speed with which decisions may need to be made in the workplace, Eraut (2000) discussed the importance of tacit knowledge in professional work. Although clinical experience is important to develop tacit knowledge, Eraut (2000) describes certain situations such as a learning environment where people talk about what they know, a mentoring relationship which can help explain professional practice issues and encourage cultural or behavioural norms possibly linked by a mediating object, for example a patient presentation or case which can help to promote discussion of tacit knowledge. The examples that Eraut (2000) gives to promote this discussion look similar to the properties of the wiki used in our module and so could promote learning something about tacit knowledge and how this is used in clinical reasoning amongst our students.

Ajjawi and Higgs (2008) explored how experienced physiotherapists learned to reason in practice. Using a hermeneutic approach, they asked twelve experienced physiotherapists from different specialist areas of practice about their learning journeys in relation to clinical reasoning to try and gain an understanding of this process so that their findings could be used to inform the education of student physiotherapists. They found that episodes which raised their participants' awareness of clinical reasoning such as articulating reasoning, complex cases or teaching students were important in the development of their participants' ability to reason, even though the participants may not have realised at the time that they were learning to reason. It was only during the research when participants were asked to reflect on their experiences that it became clear that this was when the most learning had taken place. Both Eraut's work (2000) and that of Ajjawi and Higgs (2008), emphasise the importance of talking about reasoning to others, either individually with a more experienced other or in a group to develop clinical reasoning. Ajjawi and Higgs (2012) point out that talking about clinical reasoning is not the same as clinical reasoning but represents a re-construction of the rapid, complex, multi-layered reasoning process that happens in practice. However, talking about clinical reasoning effectively must involve some knowledge and understanding of clinical reasoning (Higgs and McAllister, 2005) and slowing down and breaking up the processes involved in clinical reasoning for reflection and to explain to others can help with developing clinical reasoning abilities (Ajjawi and Higgs, 2012). When novice or student practitioners do this, they are required to explain and think about their thinking thus fostering the development of metacognitive skills (Ladyshewsky and Gardner, 2008). Using the wiki to discuss and explain the patient cases in our module could help develop clinical reasoning in a similar manner.

Babyar et al (2003) surveyed physiotherapy students who were about to graduate from 17 physiotherapy courses in New York and New Jersey, about their perceptions of tools, teaching

methods and previous life experiences that had helped develop their clinical reasoning skills. 156 students responded, a 22% response rate. A frequency analysis of the results showed that physiotherapy students perceived that their clinical reasoning skills developed as they progressed through the course, case based learning was perceived to help develop clinical reasoning the most in the academic setting, whilst discussion with clinical educators before and after the student had seen patients in the clinical setting was perceived to be most useful for developing reasoning skills in the clinical setting. Although the students suggested that case based learning was the most useful tool to help learn clinical reasoning in the academic setting, there were many different suggestions in the survey responses for how this should be used and based on these findings, the authors suggested that group discussion of clinical reasoning associated with a patient case may be one of the best ways to learn reasoning (Babyar et al, 2003). These findings support those of Ajjawi and Higgs (2008), emphasising the importance of reflection, discussion and working together to develop clinical reasoning.

Terry and Higgs (1993) described how physiotherapy educators should implement strategies which promote physiotherapy students' clinical reasoning development both within the taught part of a course and the clinical setting. The suggestions they make include encouraging learner self - direction, the use of problem-based learning, teaching clinical reasoning separately or as an integral part of specialty areas of the curriculum and helping students to become aware of their own thoughts as they start to reason. In the clinical setting, they advocate reflection on and discussion about cases and the clinical reasoning involved between student and educator. Christensen et al (2008) agree that becoming a capable clinical reasoner depends upon becoming a capable learner to make the best use of the learning opportunities which present themselves in their professional education. Similarly, Thompson and Crutchlow (1993) stated that nursing educators should use diverse pedagogic strategies in nursing education to assist nursing students to become more flexible in making use of clinical learning opportunities to help develop their clinical reasoning. For each physiotherapy student their learning opportunities associated with clinical placement will be different and so there is an element of chance in the student's development of clinical reasoning capability. Christensen et al (2008) suggest that to enhance clinical reasoning capability, students need to learn to communicate clinical reasoning, practice the skills related to clinical reasoning such as reflection, dialectical thinking and critical thinking and think about the impact of context on the reasoning process. The use of the wiki and the way it is implemented in our module facilitates the practice of clinical reasoning because students are required to develop treatment for the patient cases in the VLE in groups. The students have the chance to practice clinical reasoning and practice communicating about clinical reasoning in the

wiki environment. As the students provide evidence to support their treatment, they are developing critical evaluation skills and working in an asynchronous manner gives the students the chance to reflect on their learning. Research into how the wiki influences the development of clinical reasoning from the students' point of view, will give some insight into whether this is actually the case. Consideration now needs to be given to how TEL may offer an increased range of relevant learning opportunities for physiotherapy and other health professional students to help develop their clinical reasoning.

3.2. Technology enhanced learning and health students

In 2007, Peacock and Hooper (2007) stated that those educating health professionals had been slow to take up and utilise e-learning. They suggested that this may be because health profession education is considered to be practical skills based and much importance is placed on learning to communicate face to face with patients and other members of the healthcare team. Lowe (2008) agreed with this in her blog about e-learning in physiotherapy, acknowledging that to use e-learning in physiotherapy education required a change in mind set of the many physiotherapy educators who believed that the face to face teaching on a vocational course with a large practical element such as physiotherapy, cannot be replaced with e-learning. Research has emerged over the last decade to challenge these assumptions driven in part by the necessity to teach more students in what seems to be a cost effective method for institutions and a convenient method for the learner. Given that pre-registration physiotherapy courses require attendance at university and TEL usually takes the form of blended learning, the literature reviewed in this section will focus on this area.

Sharpe et al (2006b) carried out a review of the UK undergraduate experience of blended learning for the Higher Education Academy. Their aim was to look at existing research and practice in blended learning in UK undergraduate education, identify issues and make recommendations for future practice. Interestingly they did not define blended learning, focussing instead on dimensions of blended learning such as delivery, technology and pedagogy which they discovered in their research. They did find three main ways that blended learning was being used and discussed these based on the framework of Mayes and de Freitas (2004), which organises learning theories that have impacted e-learning developments. These are associative learning linked to repetition with accurate recall, including the development of computer resources which aim to improve student achievement, constructivist learning using exploratory activities which focus on the real world including virtual learning spaces where learners' discussion is scaffolded by more knowledgeable others and situative learning which occurs in communities of practice, including

multimedia case studies or simulated environments. Our module re-design seems to fit mainly into the second category of constructivist learning as the wiki discussions and development were scaffolded by peers and module tutors, however there is some overlap into the third category as the learning was based around patient cases and students could be considered to be working in a kind of community of practice (Lave and Wenger, 1991). Feng et al (2013) carried out a systematic review examining the effectiveness of situated e-learning on nursing and medical education. They defined this as '*...a computer assisted educational programme constructed with simulated situations, scenario based or case based learning activities...*' (Feng et al, 2013, p2). Once again, our module design could fit into this definition. Feng et al's findings were of interest because they found that situated e-learning was an effective method to improve novice medical and nursing learner's performance. They concluded that this may be because novice learners have had little experience of clinical situations. However, performance as an outcome measure is not clearly defined in this study so it is difficult to judge whether this relates to an improvement in clinical reasoning.

Blended learning can take many forms including online presentations, video streaming, podcasts, virtual learning spaces for discussion and collaboration or other virtual reality activities and online learning resources (Wong and Abbruzzese, 2011) and be supported by different pedagogical models (Allan, 2007). Sharpe et al (2006a) identified rationales for blended course designs. Four main reasons were articulated. The first was to try and maintain quality when teaching ever increasing group sizes. Blended learning afforded increased feedback opportunities for students and opportunities for small group collaboration. The second reason was to engage students out of class, the third to develop professional skills and the fourth for educational reasons to encourage constructivist learning and situated learning in a community of practice. The review recommended being clear about the reasons for taking a blended learning approach to students and clarity about expectations, roles and activities of all participants in the blended learning process. This view is supported by Anders and Thornton (2008) who used podcasting to develop oral skills for physiotherapy practice with a group of undergraduate physiotherapy students. The students were asked to work in small groups using a wiki to develop a 500 word document about one spinal pathology, for review by their colleagues and the course tutor. Each group was also asked to produce a short podcast to show how they would explain the pathology to a patient based on the information they had produced in the wiki. When the module was evaluated some of the students had not appreciated that learning communication skills was one of the aims of the activity. The module tutors highlighted the need to be clear about course objectives in the future.

Anders and Thornton (2008) demonstrate that it is possible to use TEL in novel ways to help develop communication skills, a key skill for physiotherapists.

Davies et al (2005) used a questionnaire to evaluate whether students' observational and analytical skills could be improved prior to clinical placement by providing them with a blend of traditional teaching and computer based materials (video and supporting text). The questionnaire was administered to the students after they had completed their clinical placement and 72% of the students agreed that the computer based materials had helped develop their observational and analytical skills. Follow up focus group discussions with the students highlighted how seeing the patients on the video and small group discussions about the video had helped develop these skills. Preston et al (2012) examined the effectiveness of an online training resource used with usual teaching compared to usual teaching alone on the performance of practical skills of physiotherapy students in a practical examination. The online resource consisted of video clips of patient therapist interactions, text about the interactions and extra information about each practical skill the therapist utilised. The students who had access to the online resource scored higher marks in their practical examination than those in the usual teaching group, both in performance of and rationale for the practical skill. This shows that a resource such as this can enhance both practical skill performance and clinical reasoning about why a skill may be used. These results also illustrate that giving students more options about how they learn can enhance the learning process. These examples should go some way to allaying fears of tutors and students on health professional courses who may be concerned about the introduction of TEL to their course because of the tension that may occur between developing face to face communication and practical skills, and the use of TEL. Both these examples (Davies et al, 2005; Preston et al, 2012) also support the idea that blended learning can enhance clinical reasoning in physiotherapy students. Well developed observational skills (Davies et al, 2005) are the basis of physiotherapy assessment which informs treatment in practice through clinical reasoning. Giving context to the learning about patient therapist interactions by using videos (Preston et al, 2012) has been suggested to improve clinical reasoning (Christensen, 2007).

TEL has been used in the interprofessional education (IPE) of health professionals (Clouder, 2008). This has been driven because of the large numbers of students that may need to be accommodated in these courses and the difficulties in finding space and time to do this in crowded universities. Barr et al (2005) have argued that interprofessional learning (IPL) can lead to better collaboration between health professionals in practice and better patient outcomes. Clouder (2008) explained how health professional students from two universities and a wide

range of health professions had been put into multi-professional groups of 15 to 20 with a member of academic staff as a facilitator. Each group had one face to face meeting and then completed online activities in discussion forums in their groups based on patient journeys that had relevance to the different professions. In research that evaluated this approach to IPL with the physiotherapy students who had taken part (Davies et al, 2011), it was found that students felt more confident in communicating and working with other professional groups. The authors suggested that taking part in the interprofessional TEL module prior to placement may have given the students this confidence. However their findings did not establish whether taking part in the IPL resulted in better collaboration in practice and improved patient outcome. This is an interesting finding in relation to this research because it was anticipated that one of the outcomes of using small groups of students to work on the case-based wikis in our module may lead to better collaboration and collaborative reasoning in practice.

Carbonaro et al (2008) compared the effects of using synchronous virtual classroom technology with face to face teaching. The students, a mix of health professionals doing a case based, team development course, were allocated to teams in either face to face classes or blended learning classes. There was no significant difference in the outcome measures used to assess the effectiveness of the two different interventions. Interestingly the only difference observed between the two groups was that the blended learning group felt that they had gained better team process skills than the face to face group. This finding must be treated with some caution as it arose out of a statistical comparison between the two groups of their responses to a course evaluation questionnaire, which had not been validated as an outcome measure. It would have been interesting to try and find out why the blended learning group felt this to be the case but no qualitative information was collected. This study tells us little about how e-learning may help improve team working skills from the students' point of view, just that this may happen as a result of using this kind of case based TEL. The affordances of different types of TEL may not always be immediately apparent and need further research.

Dal Bello- Haas et al (2013) examined the effects of a blended learning professional issues course compared to traditional face to face learning on knowledge and knowledge application confidence in pre-registration physiotherapy students. Their quantitative study used a confidence questionnaire administered before and after the module, module evaluation and assessment results to compare subsequent cohorts of students, the first group used traditional learning and the second a blended programme containing similar material. Their results showed that there was no difference in knowledge or knowledge application confidence between the two groups. The

students liked using the blended learning because it allowed them time to reflect before posting online, which may be helpful in developing reflective skills, but found the blended learning time-consuming compared to traditional approaches.

Bayliss and Warden (2011) compared the effects of traditional lecture based instruction with a hybrid model of student centred instruction consisting of e-lectures and small group problem solving activities in physiotherapy students learning about cardiopulmonary physiotherapy practice. This study was undertaken because the authors perceived that the use of computer assisted instruction was increasing in physiotherapy programmes and the effects of using such approaches needed to be quantified. Although the e-learning in this study was not used in a socio-constructivist manner, the small group learning activities reflect how our students may have worked together in their groups. The authors found that the hybrid model of learning appeared to improve students' performance in the higher cognitive domains of comprehension, analysis and evaluation although there was no student preference for one mode of instruction over the other. This study only shows the value of a student centred approach to learning but does highlight the need for further investigation in this area.

Wong and Abbruzzese (2011) presented three cases of learning activities demonstrating how online learning communities could be used to promote collaborative learning amongst physiotherapy students. The activities were all designed with the students working in groups to produce a product such as a video and accompanying text which was posted online so that other students could comment on the work and provide feedback. Evaluations for each case showed that students believed that working on these cases had improved their team working and clinical decision making abilities. The article lacked details about how the online activities may have contributed to these results but the authors suggested that providing collaborative learning activities was important as well as explaining the benefits of collaborative working to students and an assessment of student participation in the module. To try and overcome the risk that students would not contribute to the cases in our module, it was linked to the module assessment. Much has been written about assessment driving students learning and it is well summarised in Norman's words:-

'The curriculum tells you what the faculty are doing; the examination system tells you what the students are doing.' (1997, p265)

Clouder and Deepwell (2004) reported their reflections on some unexpected outcomes of introducing an online discussion forum to promote collaborative-learning in a physiotherapy undergraduate course. Six online forums were created for the students to discuss reflections on

critical incidents which occurred during their first 15 week, clinical placement block. The discussion was linked to a summative module assessment which used the reflections. The authors had assumed that students would participate in the discussion forums because they were linked to assessment, just as we had with our new module. Using feedback from module evaluation forms, critical incident threads posted to the discussion boards and data from focus groups with participants from each of the six online discussion forums, their findings were both interesting and unexpected. Fewer students than expected had participated in the online discussion forums and those that had had often contributed descriptively, not engaging in higher level knowledge construction, which would have been one of the main benefits of using this type of online collaborative learning. Clouder and Deepwell (2004) theorised that their students had had little exposure to debating and discussing issues in their course and that the scientific nature of their course had led to little value being placed upon knowledge construction using personal experiences. The impact of the traditional pedagogical approaches in the early part of their course may have had a significant effect on how the students used the discussion forums because the value of this method of collaborative learning had not been made clear to them. Even though we linked our e-learning to the students' summative module assessment, students may choose not to participate in the e-learning environment because the reasons for using e-learning are not clear to them and they may not consider that their thoughts and contributions are valuable in the learning process. They may not understand that discussing the patient case and their reasoning behind their thoughts may help to develop their clinical reasoning for practice.

The research presented in this section highlights some important factors to be considered with the introduction of TEL such as where blended learning may be a useful approach to student learning and whether the introduction of blended learning may affect student performance. As a wide variety of types of TEL have been presented in the research here, with different underpinning pedagogies, the benefits and difficulties reported in their use may be different to those used in our module. As our module uses a case based wiki to promote student learning, consideration needs to be given to this technology; specifically, how it may affect the students' learning experience and how the affordances of the wiki may promote the development of clinical reasoning.

3.3. Wikis in technology enhanced learning

A wiki is a collection of web pages about a topic, which can be the work of many authors. The pages within the wiki may have hyperlinks to other related information (Holmes and Gardner, 2006). The three main uses of a wiki have been described as project management, collaboration

and knowledge management (Project Locker, 2006). Although the existing research relating to TEL and the development of physiotherapy or occupational therapy students' clinical reasoning whilst on clinical placement (Newton Scanlan et al, 2006; Ladyshevsky and Gardner, 2008; Newton Scanlan and Hancock, 2010; Tan et al, 2010), utilised blogs as the underpinning technology in their work, the decision was taken to use wikis in this research. This was for several reasons. Firstly, the learning technologist who helped with setting up the original iteration of the module suggested that a wiki was an appropriate tool for our purpose and the module team, who were new to e-learning, were keen to take the advice of others with more experience. The wiki was also considered a suitable technology because the module team wanted the students to work together in a collaborative manner to produce a resource for their assessment. Holmes and Gardner (2006) suggested that wikis promote communal constructivism and collaborative learning, whilst blogs are often linked more closely to an individual. Allan (2007) also suggested that a wiki is well suited to groups of students working together to produce a resource. Finally, Snodgrass (2011) had used wikis in a blended learning module in a somewhat similar manner to our module, to help develop critical thinking and clinical reasoning skills with undergraduate physiotherapy students, so this gave support to the decision to use wikis in our module.

The decision to use wikis in our module as the main pedagogical, e-learning tool was taken to support students in active, collaborative learning and the generation of knowledge, thus supporting the socio-constructivist model of learning. An affordance of the wiki was scaffolding the student's learning about clinical reasoning, using the zone of proximal development. The literature considered in this section has been drawn from a range of areas but focuses on cases where the issues raised about wiki use are relevant to our module.

Ruth and Houghton (2009) studied how students in their mobile technologies course conceptualised wiki use and used their course design to present a wiki pedagogy. The authors commented that wikis shift the epistemology of learning as the focus is placed on 'how we know' rather than 'what is known'. Wikis allow students to deeply engage in learning by coming to know through knowledge construction or reconstruction rather than reproducing knowledge. In this knowledge (re)construction, the individual voice is important in producing a final collaborative product which could not have been produced without the individual input and the authority becomes shared by the users. Ruth and Houghton (2009) also argued that much has been published about the potential of wikis for collaborative learning and outcomes of use rather than considering the processes involved in how a wiki may produce these outcomes. As the epistemology of learning shifts when wikis are used, the task that a group of wiki users undertake

needs to be authentic (Bower et al, 2006) and require the group to work collaboratively for a successful outcome (Choy and Ng, 2007). These points are all important in our module. The shift away from behaviourist pedagogy towards that of constructivism and the construction of knowledge meant that students had to learn how to approach their learning in an entirely new way but the case based learning did provide an authentic task for the students to complete in a collaborative manner, which could be considered similar to the way in which students would work in practice. This research will explore how the students experienced this in relation to learning clinical reasoning.

A study that supports the notion that a wiki task should be authentic and based on collaboration to achieve an outcome is that of Mirk et al (2010) who implemented a wiki in a third year pharmacy elective course to allow students to collaborate and share information related to landmark trials in primary care. This was in response to increasing class sizes to make the learning more student-centred and self-directed. There was no tutor input to the wiki apart from uploading student handouts to make a wiki page for further student discussion. Student participation in the wiki allowed them to accrue some points towards their final mark for the module but they could also do this by participating in class. A pre- and post-course survey were administered to the students. The pre-course survey focussed on students' prior use of wikis and the post-course survey on the student experience of using the wiki. Half of the students reported using a wiki to search for information in the pre-course survey but none had contributed to a wiki. Results from the post-course survey showed that the students who used the wiki during the course were positive about the collaboration because it helped to clarify course content but the majority of the students were ambivalent or would not recommend using a wiki in other courses. Little information is given about why the students would not recommend using a wiki in other courses. Students could feel like this because if they had not participated in the wiki, they would not have had any meaningful interaction with others. Woo and Reeves (2007) stated that meaningful interaction is required in VLEs to lead to substantive learning. Meaningful interaction must stimulate the learner and engage them in meaningful activity, which directly influences their learning (Vrasidas and Mclsaac, 1999). Meaningful interaction is closely related to learning theories which underpin the type of learning activity which is being used. If students are used to playing a more passive part in their learning as in the type of learning underpinned by behaviourist learning theory, they may not realise that they can learn by participating in a socio-constructivist learning environment and think that their participation would be just a waste of time (Woo and Reeves, 2007). This may be the case with some of our students who are used to a

more traditional way of learning, directly from a teacher rather than from discussing the opinions and thoughts of their peers about a patient case.

Elgort et al (2008) reported on the results of a questionnaire used to evaluate two courses where students worked either in a wiki group to produce a report and presentation about a leading edge technology or a web-based guide to online resources in a specific subject area. Course instructors' feedback was also collected in a de-briefing session. They found that although students agreed that doing group work was a valuable experience and that the wiki was a valuable tool for organising group work, most would have preferred to complete the assessment for the course on their own. Some students thought that working in the online environment meant that the associated coursework required less academic rigour. This was also linked to the instructors commenting that there was less evaluation evident in the work produced in the wiki and that strategies needed to be put in to place in the wiki environment to encourage students to engage critically with resources. This is again a report of a course evaluation which does not investigate why these results were found but does raise an important point about critical thinking skills which have been linked to clinical reasoning (Brudvig et al, 2013; Huhn et al, 2013). In an effort to encourage critical thinking skills in our module, we asked students to provide a rationale based on evidence for their chosen treatment plan, to try and avoid learners interacting with each other in a manner that did not lead to substantive learning.

3.3.1. The wikis in the cardiorespiratory module

A specific structure was imposed on the students' wikis in our module as there was a treatment grid attached to each wiki (Figure 3.1a and Figure 3.1b). This structure was used to model how patients' problems and treatments may be written in clinical practice so that the students could practice this and to demonstrate their thinking in relation to formulating problems and treatments for the patient cases. Each time the students wanted to add, change or delete something from the grid, they were asked to explain their rationale for doing so in the comments section of the wiki. This immediately places a constraint on the way in which a student uses the wiki, the information the group may generate and how they participate in the learning group. In contrast to the way we were proposing to use wikis, Lund (2008) argues that the structure of a wiki should emerge as a result of participation because of its open design. For educational purposes where students are required to meet defined learning outcomes linked to an assessment, the notion that '*Anyone can add to, edit and even vandalise...*' a wiki (Shareski and Winkler, 2005, p6) as has been the case with Wikipedia (www.wikipedia.org), becomes a rather idealistic one. From a purely pragmatic point of view we required a set of ground rules for the use

of the wikis because of the number of students and wiki groups in the cohort. This made the module seem to have a complex structure and design, which may have been confusing for students, created a potential barrier to learning and affected whether they wanted to engage with the learning environment or not.

Another reason for imposing a structure on the wikis in the module was to provide 'scaffolding' for the learners. Wood et al (1976, cited by Holmes and Gardner 2006) has described scaffolding as a means to help learners reach new levels of knowledge, skills and understanding that are just out of their reach. This relates to the concept of Vygotsky (1978) who first described the 'zone of proximal development' in the 1920s, where an expert (in our case a tutor) or more knowledgeable other (a fellow student or tutor), guides a learner who already has some knowledge or skill to reach the next level of understanding.

It was important for the students to develop the patient treatment grids for the module assessment and understand how their learning would feed into clinical practice, but their underpinning thoughts and reasoning for what they placed in the grids, the comments section of the wikis, provided the information to make sure that their understanding was developing in an appropriate manner and allowed module tutors to help guide their thinking.

As the wikis were part of a blended learning package and the students were attending the university regularly, whether the students discussed information in groups and then filled in their grids on the computer or actually used the wikis to communicate with the other members of their group, filling in the grids and writing comments in an asynchronous manner had not really seemed to matter when the module was devised. The wiki was a pedagogical tool to stimulate collaborative-learning. However it soon became apparent that if students did not use the comments section in the wikis, it was very difficult to give feedback of the same detail and quality compared to those students that were making use of these areas. It is well recognised that regular feedback will enhance student performance (Boud, 2000) and within the wikis there was a regular opportunity to complete the feedback loop and for students to show improved performance. For those students who chose not to fill in the comments section on the wikis, the detail of feedback that they received about their grids as they developed may have affected their experience of the e-learning environment.

 Sample Wiki

Create Wiki Page

Sample Case: A person with asthma

Edit Wiki Content

Created By Anonymous on Tuesday, 7 June 2011 15:26:09 o'clock BST
 last modified by Anonymous on Tuesday, 7 June 2011 15:44:35 o'clock BST

Clare is a 24 year old who was admitted to hospital yesterday with an acute exacerbation of her asthma. She has been unwell with a cold for the last week.

She was treated overnight with 2 hourly salbutamol nebulisers and IV hydrocortisone. She is currently SOB on minimal exertion and she has a cough productive of sticky white secretions. On auscultation she has wide spread polyphonic wheeze and basal crackles.

Physiotherapy problem	Physiotherapy treatment	Clinical Reasoning	Underpinning Evidence
Retained secretions	ACBT		
...	do ACBT ?with assistance while unwell.	TEE should not have a hold as may make them SOB.	?
...	2 x day until 2 clear cycles, or until tired.	Have longer periods of BC to allow for SOB Huff instead of cough will minimise risk of further bronchospasm	Pryor J et al (1979) Br Med J 2; 417-418. Found that FET does not increase obstruction in people with reactive airways, although this study was in people with CF, not asthma. Bateman (1982)
	Teach to do independently when well to prevent secretion build up.	People with asthma have impaired mucociliary clearance and if this isn't cleared they could be prone to a build up of secretions.	Samransamrujkit R (2003)
...	Flutter	Physiotherapy using a flutter improved lung	Swift GL (1994) Respiration

Figure 3.1a to show screen capture of the upper part of an example of the wiki structure used in the module.

			CF, not asthma. Bateman (1982)
	Teach to do independently when well to prevent secretion build up.	People with asthma have impaired mucociliary clearance and if this isn't cleared they could be prone to a build up of secretions.	Samransamrujit R (2003)
...	Flutter	Physiotherapy using a flutter improved lung function more than drug treatment alone. In severe asthma the flutter increases sputum clearance	Swift GL (1994) Respiration 6:(3) 126-9sham vs flutter Gegla (2002)
...	Comet	In COPD comet produces improvements in lung function and decreased hospitalisation in comparison to drug treatment alone. Works on the basis of oscillatory PEP	
Risk of repeated infections	Education re management of asthma	Learning how to monitor her asthma may reduce future hospital admissions	British Thoracic Society (2008) British Guidelines on the Management of Asthma (see link in the comments section)
Shortness of Breath	Positioning to relieve breathlessness Breathing control	Forward Lean sitting & High side lying can be used to relieve SOB. These positions work by relaxing the muscles of the sholder girdle and upper limbs which are accessory mm of breathing and also through the pressure of the abdomen from flexion at the hips causing the diaphragm to work in a more efficient range.	O'Neill & McCarthy 1983, Thorax 38, 595-600 Fwd lean sitting produced greatest inspiratory pressure in people with severe / moderate COPD. Most patietnts preferred this position.

Physiotherapy Assessment Techniques
Auscultation
Lung function testing
CXR

≡ [Comments: 0](#)



Figure 3.1b to show screen capture of lower part of an example of the wiki structure used in the module.

The imposed structure on our wikis shows that there may be some difficulty in comparing literature looking at the pedagogical effectiveness of 'wikis'. Although there is a broad definition of the technology, the applied constraints to use, the context in which the wiki is used and exactly how the wiki is being used require careful scrutiny to make valid comparisons of its effectiveness as a pedagogical tool and the student experience of using the tool in relation to this. Rather than trying to compare technologies or virtual learning environments, it seems more sensible to compare the 'affordances' of the technologies or the relationship of the attributes of the technology to its potential value in the-learning process (Day and Lloyd, 2007) but only when these are seen as part of the whole-learning context. The potential affordances of the wiki with our group of students would be the opportunity to develop critical thinking skills and practice clinical reasoning and communicating clinical reasoning, by using the zone of proximal development to allow the generation of knowledge and understanding for the clinical practice and the assessment. However these affordances must be considered in the light of other

contextual factors such as the learning styles of the learners, what the learners understand about knowledge, whether they understand how participation in the wiki may contribute to their learning, as well as the fact that the wikis are being blended with other kinds of learning. All these factors would affect the students' experiences of the e-learning environment and how the wiki influenced their development of clinical reasoning given the link between a student's ability to make the most of a learning opportunity and their clinical reasoning development (Christensen, 2007).

Minocha and Thomas (2007) evaluated the use of wikis in a software engineering course in a blended learning environment. Their wikis were implemented in a similar manner to ours in that students were given three 'cases' in software engineering throughout the module and asked to collaboratively develop the requirements documentation for the software. This would seem similar to physiotherapy students developing a treatment for a patient based on a case presentation. The authors were particularly interested in how the wikis functioned to promote collaborative-learning. In a well designed study, an inductive analysis of student feedback and reflective statements about the course were used to investigate this. They found that the wikis appeared to help with learning course material. There was some reservation about the collaborative nature of learning amongst the students. This related to the asynchronous nature of wiki use, relying on other group members to make a contribution or respond when there were assignment deadlines to meet. There was also some reluctance demonstrated in relation to changing or disagreeing with the contributions of others to the wiki and some felt that this kind of assessment by their peers was not helpful. These findings would benefit from further investigation as they could become a real obstacle to student learning in the wiki environment. Although this investigation looked at a collaborative e-learning environment, reluctance amongst students to participate in peer assessment in face to face collaborative-learning environments is not uncommon (Reynolds and Trehan, 2000).

3.4. Learning clinical reasoning and technology enhanced learning

There is some literature related specifically to learning clinical reasoning and the use of TEL using a form of collaborative technology and /or case based learning. The literature considered in this section has an explicit aim about using TEL to foster clinical reasoning and is taken from both the academic and clinical parts of health professional courses.

Snodgrass (2011) evaluated a blended method of teaching clinical reasoning using a wiki. A class of third year physiotherapy students were divided into groups of six or seven and allocated a

clinical mentor to provide feedback on the students' contributions to the wiki. Each group was tasked with presenting a patient case and the clinical reasoning underpinning the case to the rest of the group. The groups used a wiki as a tool to discuss and develop their thoughts about the case to form a basis for their presentation. Students were awarded a group mark for the presentation and the wiki, and individual marks for their contribution to the wiki and their own learning journal. Data were collected by questionnaire administered in the final teaching session and three focus groups during the final two weeks of the module. Wiki usage patterns were obtained from the group wikis. The students felt that the wiki was useful for revision and to promote collaboration amongst students, although some also felt it was time consuming and awkward and were worried about the accuracy of the information contained within the wiki. A major review of the literature related to the student experience of blended learning in higher education (Sharpe and Benfield, 2005) also found that students had difficulty managing their time in the virtual learning environment (VLE) and that students lacked confidence in putting their ideas into writing in VLEs. This lack of confidence may account for students doubting the accuracy of information in the wiki in the study by Snodgrass (2011) or possibly that they were used to a more traditional didactic approach to learning, just as the students in our module. Snodgrass (2011) did raise some important points about how the wiki may help students develop their clinical reasoning skills. Critical thinking was required to consider and evaluate other students' opinions and contributions to the wiki and in responding to comments and questions from other students and mentors, students were learning to interact with others in a similar manner to that used by health professionals in practice.

Rowe et al (2013) evaluated the introduction of case based learning and technology into a second year applied physiotherapy module. The module was changed in response to comments from an external examiner that final year students on their course displayed a lack of clinical reasoning skills. Previously their students had been taught the module content using lectures and course readers. This bears some resemblance to the change in pedagogy when TEL was introduced to our students. In Rowe et al's study (2013) students worked in small groups with moderators on clinical cases to promote clinical reasoning and critical thinking using Google Drive. Exact details of the module set up are not given in the article. Focus groups were used to evaluate the intervention and data thematically analysed. The findings were that students' perceptions of learning had been transformed from not just regurgitating information but to being able to say why something could be done, their critical thinking had been developed in that they felt ready to question why things should be done and the power relationship as part of learning had changed for the student. The final theme may be because of the open nature of Google Drive, the software chosen for this

project, which allowed students to take responsibility for their learning because the VLE could be adapted as the students wished rather than having the module tutor decide on the structure of the learning environment as is the case with the UVLE in the institution where this research took place.

Other physiotherapy researchers (Westwater-Wood and Dennick, 2011; Seif et al, 2013) have used case study based e-learning tools to foster clinical reasoning skills. Both groups developed e-learning tools which contained a video or audio taped patient assessment, other documents relating to the patient case such as referral letters and literature searches pertaining to the patient case. Westwater-Wood and Dennick (2011) evaluated their e-learning tool using a questionnaire which they had developed, containing both open and closed questions. This was administered to students who had used the learning resource. They found that students felt that the learning approach had facilitated their clinical decision making skills and also that the students did not want TEL to become the dominant approach in their course. Seif et al, (2013) used a standardised questionnaire, the Self-Assessment of Clinical Reflection and Reasoning (SACRR) both before and after their students had participated in their learning activity to assess development of clinical reasoning and an instructor developed questionnaire to assess student satisfaction with the e-learning approach. They found a statistically significant improvement in the results of the SACRR after students had participated in the module and that students were satisfied with the learning approach from the instructor developed questionnaire. Seif et al (2013) did concede that the improvement in SACCR scores may not just have been due to their module as students were taking part in other lessons that may have helped develop their clinical reasoning skills concurrently. This is an important point to consider in the current research because this research identifies the specific influence of the case based wiki in the development of the students' clinical reasoning capability as part of the whole physiotherapy course. The SACRR was also a newly developed tool which had not been widely used in physiotherapy students' education and needed further validation in this area. Although both studies (Westwater-Wood and Dennick, 2011; Seif et al, 2013) could be criticised for using questionnaires which they developed themselves and a newly developed instrument that had not been validated in physiotherapy education, there is some agreement between the studies that the use of TEL may have helped develop their students' clinical reasoning skills.

3.4.1. Clinical placement, learning clinical reasoning and technology enhanced learning

There is a small body of evidence which suggests that clinical reasoning skills may be promoted when students on clinical placement are also asked to participate in a collaborative virtual

learning environment (VLE). In a study similar to that of Clouder and Deepwell (2004), Ladyshevsky and Gardner (2008) explored whether blogging and peer learning strategies may enhance clinical reasoning skills by supporting reflective practice in clinical placement. Final year physiotherapy students who had 15 weeks of clinical placements remaining, were placed in a blogging group with four other students and a moderator. Students were asked to blog on issues of professional practice or evidence based practice and required to make two of their own blog entries and four comments on other blog entries over the duration of the project. Students participated in focus groups to feedback on their experiences with the blog. Findings revealed that students liked blogging because of the informality, support from peers and the moderator and that they could access the blog anytime and anywhere. There were some problems experienced with the technology and the size of the groups were felt to be too small where students did not participate as they should. Students commented that the blog allowed them to process and structure their thoughts more helpfully as they were going to write them down to be read by others. The authors concluded that the blogging experience had created small reflective practice networks or communities of practice, which created social constructivist discourse that could enhance the students' development of professional practice and competency (Ladyshevsky and Gardner, 2008). This evaluation of a new pedagogical development to enhance reflective practice does serve as a description of a strategy that could be used and as a basis for future research rather than giving any detailed explanation of or theory about how the blog enhanced reflective practice in this group of students. The use of a blog in this manner is further supported by Bodell et al (2009) who suggested that blogging can be used as a tool for continuing professional development (CPD) in occupational therapy by creating an international learning community. In an opinion piece, they commented on the growing number of occupational therapy blogs and how these could be used to aid reflection on practice, develop writing skills and demonstrate engagement in CPD activities such as extending knowledge and demonstrating peer discussion and debate.

Building upon Ladyshevsky and Gardner's work (2008), Tan et al (2010) explored the potential of blogs to promote clinical reasoning and metacognitive skills in final year physiotherapy students whilst they were on clinical placement. Students were divided into groups of nine or ten and asked to post one reflection and comment on two posts of other group members for the duration of the project. The blog content of five groups were randomly selected for analysis and analysed using principles of grounded theory until theoretical saturation of the data was reached. The blogs were coded using clinical reasoning definitions from the literature and then for evidence of meta-cognition using definitions described by Green (2005) as spaces of influence that take place during

learning with others. The authors found that there was evidence of ethical, procedural and interactive reasoning in the blogs and that metacognitive skills were demonstrated. This research provides some evidence that in this group of physiotherapy students, blogging can help with the development of clinical reasoning skills whilst they are on placement but does not give any insight into whether the students realised the value of the blogging in the development of their clinical reasoning capability.

Newton Scanlan et al (2006) explored whether introducing online asynchronous discussions to occupational therapy students whilst on placement, supported the development and refinement of clinical reasoning skills. Students were grouped according to their current clinical practice area and asked to discuss patient cases from their area, starting the discussion by posting a patient outline and then being required to make at least two postings of suggestions for other patients. The transcripts of the online discussions were analysed using a hybrid instrument developed from Murphy's (2004) instrument for analysis of critical thinking in online asynchronous discussions and Higgs and Jones' (2000) model of clinical reasoning. This gave five categories, understand, analyse, evaluate, metacognitive reasoning and decision making into which the data was sorted. The data fitted overwhelmingly into the understand category and the authors concluded that provision of a virtual space for online discussions with minimal structure was not enough to support students in the development of their clinical reasoning skills but further thought was needed to structure the VLE and scaffold the students' learning appropriately (Newton Scanlan et al, 2006).

Building upon this research, Newton Scanlan and Hancock (2010) evaluated whether the introduction of a structured framework to guide online discussion between occupational therapy students whilst on placement improved the amount of cognitive elements of clinical reasoning within the discussion. They provided the students with a framework for clinical reasoning (Mattingly and Fleming, 1994) and introduced structure into the discussions by asking the students to take on specific roles in the discussion groups and by dividing the clinical reasoning process into three phases of assessment, intervention and evaluation. Students were required to make at least one post for each week they were on placement. Their analysis revealed an improvement in the depth of clinical reasoning within the discussions when the framework was introduced compared to that of their original study (Newton Scanlan et al, 2006). In some ways this is hardly surprising as providing the students with a clinical reasoning framework would help the students understand what they should be learning about clinical reasoning. Newton Scanlan and Hancock (2010) also asked students to complete the SACCR instrument to measure change in the students' clinical reasoning ability before and after their fieldwork placements. These results

also showed an increase in clinical reasoning ability but this may be as a result of being on clinical placement rather than as a result of participation in the online discussions. The authors concluded that further development and research into this area was required. From this small body of research, it seems that if TEL is to be used to enhance clinical reasoning, the technology needs to have a structure which scaffolds the learner and attention should be drawn to clinical reasoning. The structure of the wiki in this research was designed to scaffold the learner by directing the students to develop a process of thought associated with reasoning in practice, providing feedback on their developing thoughts and highlighting the clinical reasoning used to arrive at a suitable treatment for the patient.

3.5. Justification for this research

From reviewing the literature related to this research, there seems to be a reasonable basis of research and knowledge which would support the use of a case based wiki, as a learning experience that could be used to facilitate development of undergraduate physiotherapy students' clinical reasoning.

Clinical reasoning has been described as the basis of professional practice in physiotherapy (Higgs and Jones, 2008) and that learning experiences in traditional, pre-registration physiotherapy courses may neglect the development of clinical reasoning and thus the link between theory and practice, (Christensen et al, 2008). Christensen (2007) has described 'capable clinical reasoners' as those students who are able to make the most of different learning experiences and those who have developed sound thinking and learning skills such as critical reflection and evaluation. The introduction of a new learning experience such as a wiki, which requires students to discuss and plan treatment for a patient case in a group and find and evaluate literature to support the treatment, should promote sound thinking and learning skills as well as give the students the opportunity to experience and learn how to use a different kind of learning.

The clinical reasoning literature illustrates the value of taking a case based approach to learning clinical reasoning (Boshuizen and Schmidt, 1992; McKenzie, 2000; Jensen et al, 2000) so that students can contextualise the learning and practice thinking which allows connections to be made between different subject areas in a course, thus allowing the students to start to think as they would on clinical placement. Case based learning places the patient at the centre of a learning experience, just as expert physiotherapists place the patient at the centre of their practice (Jensen, 2000) so emphasising the importance of patient centred practice. The use of patient cases allows students to practice communicating about clinical reasoning, which has been

shown to develop clinical reasoning (Ajjawii and Higgs, 2008; Christensen et al, 2008). Both Eraut (2000) and Terry and Higgs (1993) suggest that learning experiences such as patient cases, which promote discussion, can help develop clinical reasoning and allow the practice of clinical reasoning prior to placement when there may be little time for decision making on clinical placement (Eraut, 2004; Smith et al, 2007). Eraut (2000) goes on to say that learning environments which allow people to talk about what they know and include a mentoring type relationship which encourages cultural norms, can help develop tacit knowledge, which is an important part of clinical reasoning. The wiki environment could be conceptualised like this because it allows discussion and the mentoring type relationship could be seen as the more knowledgeable other, the tutor or fellow student who gives feedback and comments on students' contributions to the wiki. This warrants further investigation.

The introduction of a new module, which has a different underlying learning theory to that of the course of which the module is part, may be a difficult experience for the students, (Sharpe et al, 2006b) and even become a barrier to learning (Cramphorn, 2004). Our module which is based upon constructivist pedagogy was introduced into a traditional course based on behavioural pedagogy. There is an element of uncertainty about the different ways in which our module influenced the students' learning. For the new learning experience to be useful, students need to engage in meaningful interaction (Vrasidas and Mclsaac, 1999) in the wiki to achieve the potential benefits of using this kind of learning experience. Clouder and Deepwell (2004) have commented that physiotherapy students are not accustomed to debating and discussing issues and that they may not place value upon knowledge construction using personal experiences. Currently the way we use the wiki and whether it contributes to the development of the students' clinical reasoning in the way we theorise that it may, is unclear so this warrants further exploration.

The physiotherapy profession has been rather slow in the uptake and use of TEL (Peacock and Hooper, 2007) because the importance of face to face communication and learning practical skills has been emphasised. Some research has started to emerge in this field which shows the benefit of TEL in education in this field both in generic physiotherapy skills (Davies et al, 2005; Anders and Thornton, 2008) and clinical reasoning (Davies et al, 2005; Preston et al, 2012). However this research seems to emphasise how well received the learning experience was and whether it affected students' grades (Davies et al, 2005; Preston et al, 2012). These are important considerations but more emphasis needs to be placed on how the experience affected the students' learning and their thoughts about this. The TEL in these studies did not use a wiki and was not carried out in a constructivist manner. There are existing studies (Tan et al 2010; Newton

Scanlan and Hancock, 2010) which have shown that clinical reasoning can be developed by using TEL in a collaborative manner whilst students are on placement. The results of these studies indicate that there may be benefit in using TEL prior to clinical placement to develop clinical reasoning. The research proposed here will address these issues and add to the body of knowledge in the area.

In the wider context, universities are attempting to embed the use of digital technologies in learning and teaching and management systems to attract students to their institutions (HEFCE, 2009; University Strategic Plan, 2012). The Department of Health, who commissions physiotherapy education, is requiring that TEL interventions are evidence based (DH, 2011). These are strong drivers for this research.

Now that this module has run several times, feedback from students who have completed the module and their educators whilst they are on cardiorespiratory clinical placements, continues to suggest that students have developed improved clinical reasoning and collaborative working skills. However the mechanisms by which these improved skills have developed is not clear. As students have had the opportunity to learn about clinical reasoning and work together in their wiki groups to develop these skills prior to embarking on placement, they may be better able to clinically reason as they start their placements and keep up with the speed of clinical practice by building on these foundations. This warrants further investigation particularly from the student perspective and will therefore form the basis for this piece of work. The aims of this research are:

1. To investigate and understand whether, and if so how, participating in a case based wiki prior to clinical placement helps to develop clinical reasoning from the pre-registration physiotherapy students' perspective.
2. To critically assess the implications of using a case based wiki to facilitate the development of clinical reasoning in pre-registration physiotherapy students prior to clinical placement.
3. To explore the use of sociocultural theory as a framework to consider the contribution a case based wiki may make to the development of clinical reasoning skills in pre-registration physiotherapy students.

4. Chapter Four: Methodological Approach

Cresswell (2007) explains that *'Qualitative research begins with assumptions, a worldview, the possible use of a theoretical lens and the study of research problems inquiring into the meaning individuals or groups ascribe to a social or human problem.'* (p37). This chapter will focus on the design of this piece of qualitative research and consider the underlying theoretical perspective, the choice of methodology and proposed methods. The chapter will explain how these elements inform each other to produce a coherent research process and a justification for the chosen design (Crotty, 1998).

4.1. Theoretical perspective

The theoretical perspective for this piece of research is informed by the underlying epistemology and ontology for the research. Epistemology is concerned with the nature of knowledge and truth (Somekh and Lewin, 2005). It is concerned with the understanding of how we know what we know and how knowledge is communicated to others. In relation to this piece of research it is important to establish whether it will identify an underlying objective truth or whether there will be multiple meanings and interpretations to consider based in the research participants' perceptions and experience. The positivist tradition encompasses the belief that research will find 'true' knowledge about a 'real' world, which is not open to individual interpretation (Finlay, 2006). This piece of research is concerned with developing an understanding of how participation in a case based wiki influences the way in which physiotherapy students develop their clinical reasoning. It is assumed that each student will have their own values, thoughts and experiences in relation to developing their clinical reasoning, so this piece of research is based in the interpretivist tradition, which allows for multiple meanings and interpretations of an experience.

Ontology is the study of being (Crotty, 1998) and is based on the researcher's view of the world. It is concerned with the nature of reality and whether there is one reality or multiple realities. As a physiotherapy lecturer with a long background in clinical physiotherapy my own understanding of knowledge and meaning making has been deeply influenced by these experiences. Fox et al (2007) have acknowledged that how a practitioner frames a piece of research:-

'...will partially depend on their professional background, training and experience.' (p8)

My training as a physiotherapist followed a traditional approach. The pedagogy of my training course was strongly underpinned by a behaviourist approach to learning. We were largely encouraged to work independently even though for most of our professional lives we would be

working collaboratively with others in teams. Facts were fed to us and we regurgitated these in exams to progress to the next level of the course and in qualifying exams set up by our professional body so that we obtained a license to practice as a physiotherapist. This model of education closely resembled the medical model, which is strongly linked to the realist or objective world view (Fox et al, 2007). Research based in the realist tradition supports the notion that there is a real observable world, which can be verified using scientific research, including methods such as experiments to test hypotheses by using reliable outcome measures and is based in the positivist tradition. This real, observable world is objective and not open to individual interpretation according to one's culture, beliefs or language. This objective world view dominated the healthcare world for a long time. The opening paragraph of the Research and Development Strategy for the National Health Service (NHS) (Department of Health, 1991) states that:-

'Strongly held views based on belief rather than sound information still exert too much influence in healthcare.' (p2)

This document appeared at the start of the then government's push for evidence based health care and demonstrates a realist view of the world. Best practice in the medical world is regarded to be that which is evidence based. Although the term evidence based healthcare has been interpreted in a variety of ways, at the time of my clinical experience, it was most commonly based on a hierarchy of strength of evidence, where the best evidence comes from a systematic review of multiple randomised controlled trials – the gold standard in scientific research, with any research consisting of small scale studies considering experiences, individual opinions or beliefs of either patients or health care staff coming right at the bottom of the hierarchy (Bury and Mead, 1998). As a practising physiotherapist at this time, I was strongly influenced by this positivist view of the world linked to quantitative research methods. It was important to have a good understanding of evidence based care from the medical point of view so that I could work in a multidisciplinary team and incorporate new research into practice in a way that suited the culture of the team. However, working with patients from different cultures and backgrounds soon made me realise how important individual realities are in managing health problems for different patients. In determining the best treatment for a patient, a sound knowledge of the patient's condition and related research is important but even more important is whether this research can be applied to an individual patient in light of their experience of an illness and their beliefs and preferences. Sackett and colleagues, who were some of the original proponents of evidence based medicine in the United Kingdom, described best medical practice as that which would allow patients to be active participants in decisions about the best treatment for them, based on

current research evidence and the clinical experience of the medical practitioner (Sackett et al, 1996). In this description, Sackett et al (1996) show how health practitioners need to use research evidence alongside their clinical experience and the practical wisdom that they have learnt from this, in a collaborative manner with their patients to inform their clinical decisions about treatment. This reflects how physiotherapists use clinical reasoning in their practice and as I started to learn practical wisdom, my world view started to shift to one that places more emphasis on multiple, socially constructed realities and the use of qualitative research methods.

My background as a clinical physiotherapist is in the cardiorespiratory field. This involved treating patients who were critically ill in the intensive care unit and patients on wards, in the outpatient department or in the community with acute or chronic illnesses. In any one day, my work may have taken place in any of these environments and so this involved working collaboratively with several different teams at once to try and provide the best care for patients. The environment that you work in may affect the way that you view the world at any one time. In the intensive care unit where patients are critically ill and treatment interventions that you carry out may have an element of risk involved with them, it is more comfortable to believe that how a patient responds to a treatment will be governed by an objective set of rules that are informed by scientific research in the area. This would form one end of a spectrum of how I would be comfortable in making meaning at a specific point in time – a positivist view of the world. The other end of my spectrum would be based in the interpretivist view, which acknowledges that each individual has his own experiences which construct his own reality. For example, if I were working with an individual patient who had a chronic lung disease in their own home, an understanding about their experience, culture and health beliefs would be critical to help provide an effective rehabilitation programme for them. The individual's perceptions of the world form the basis of their reality (Guba, 1990).

In both the intensive care unit and the community, it has been suggested that a physiotherapist working in the cardiorespiratory field will use constructionist principles in their clinical decision making (Smith et al, 2008). Collaboration occurs with individual patients during clinical decision making to try and provide the most suitable treatment whilst it has also been shown that where there is a larger risk with a particular treatment, as in the intensive care unit, the decision to use that treatment will be made collaboratively between the physiotherapist and other members of the multidisciplinary team (Smith et al, 2008). As an educator, this theme of collaboration has continued in my work, for example working with colleagues from a similar clinical background to produce a module which reflects current physiotherapy practice in the respiratory field, through

which we can facilitate the learning of physiotherapy students in a collaborative manner. Working with students collaboratively means recognising their prior experiences, values and motivations and how this will influence how they make meaning from their learning. For me, the underlying thread through my work as a clinical physiotherapist and as an educator is one of collaboration with meaning making based in the multiple realities and experiences of those involved in a particular time, place or situation. This fits with the constructivist research paradigm.

Constructivism asserts that:-

'...realities are social constructions of the mind, and that there exist as many such constructions as there are individuals (although clearly many constructions will be shared).' (Guba and Lincoln, 1989, p43)

It should be acknowledged that the terms 'constructivism', 'constructionism' and 'socio-constructivism' are often used interchangeably in the literature. All are concerned with the production of meaning by people (Braun and Clarke, 2013). Crotty (1998) suggests that constructivism relates to meaning making of an individual whereas constructionism is concerned with the social generation of meaning. Crotty (1998) goes on to say that a constructivism based on individual meaning making resists criticality because each individual's position is as valid as any other, whilst social constructionism, which emphasises collective meaning making gives a definite view of the world and a position from which to be critical. Kanselaar (2002) describes two historical strands of constructivism, that of Piaget, which he calls cognitive or radical constructivism, which takes an individual perspective in meaning making and that of Vygotsky, which he calls socio-cultural constructivism, that takes a socio-constructive perspective; meaning is based in social generation. Kanselaar (2002) goes on to say that both types of constructivism could be considered to have abandoned the realist position of knowledge as a representation of truth in favour of a relativist position in relation to knowledge, represented as an active, personal construction in which meaning is given to socially accepted and shared ideas. This disagrees with Crotty's (1998) view of constructivism being solely related to individual meaning making, which resists criticality. From these two authors' (Crotty, 1998; Kanselaar, 2002) descriptions of constructivism, there is some confusion in the terms they use to describe similar positions and how they interpret these.

As this piece of research will explore how the experience of participating in a case based wiki prior to clinical placement contributes to the development of clinical reasoning skills from the pre-registration physiotherapy students' perspective, an experience which is grounded in a social context of making meaning collaboratively, a constructivist approach, based in Vygotsky's socio-constructivism (Kanselaar, 2002) or social constructionism (Crotty, 1998), is the most appropriate

here. This approach also acknowledges how students construct meaning in their experience of developing clinical reasoning skills, that many of these constructions are shared (Guba and Lincoln, 1989) and that the resulting representation of their experiences is based on the researcher's interpretation.

4.2. Methodology

There are several methodological approaches which could be taken to fit with my theoretical perspective and inform the methods of data collection. Clinical reasoning in physiotherapy has been researched using several different methodologies including grounded theory (Resnik and Jensen, 2003; Edwards et al, 2004; Cruz et al, 2012) and phenomenology (Ajjawi and Higgs, 2012; Christensen, 2007). Grounded theory as described by Glaser and Strauss (1967) uses data inductively to produce a theory to answer a research question. Rather than developing a theory about how participation in a case based wiki influenced the development of clinical reasoning in undergraduate physiotherapy students, this research aims to develop a greater understanding of how participation in the wiki influences the clinical reasoning of the students so grounded theory will not be used here.

Phenomenology has been defined as:-

'...the study of lived, human phenomena within the everyday social contexts in which the phenomena occur from the perspective of those who experience them' (Titchen and Hobson, 2005, p121)

This definition seems to fit with the research question comfortably, the phenomenon being taking part in a case based wiki to develop clinical reasoning, the social context the physiotherapy course and the students experiencing the phenomenon. This piece of research could be carried out using the direct approach to phenomenology, which is based on the work of Husserl (1859-1938), who separated conscious actors in a world of objects and asked research participants to consciously reflect on and discuss their subjective experience of phenomena before interpreting and representing these as objective constructions (Titchen and Hobson, 2005). However if this approach were taken the research would take on a more individual perspective, my interpretation of individual realities rather than a constructivist one, which places more emphasis on making meaning through social collaboration, making meaning with the students to represent their experience.

TEL has been researched in many different ways but emphasis has been placed recently on learning being viewed as a socially organised activity, and that what people learn in specific

settings depends upon how the learning is organised from a social and institutional point of view and any technologies used in the learning process (Ludvigsen et al, 2011). Ludvigsen et al (2011) go on to argue that the adoption of sociocultural approaches to learning in recent times have had a big impact on research related to TEL and the setting in which it takes place, because digital technologies create new ways of learning and communicating. They also state that sociocultural theory is an important tool for understanding change in this field. Sociocultural theory was first developed by Vygotsky and colleagues in Russia in the 1920s and 1930s in relation to learning and development (John-Steiner and Mahn, 1996) and is recognised as a type of constructivism. Rather than emphasising the intrapersonal process of individual knowledge construction or that meaning is entirely socially negotiated, sociocultural approaches recognise that social and individual processes are interdependent in the co-construction of knowledge (Liu and Matthews, 2005). Vygotsky (1978) theorised that humans exist and are active in cultural contexts, that the activities are mediated by language and other tools and that the way human activities should be looked at is in relation to their historical development. This reflects how our students develop their clinical reasoning and so their clinical reasoning development could be considered using a sociocultural approach. Ludvigsen et al (2011) emphasise this point, stating that we need to develop understanding of how specific learning activities are enacted so that we can understand why and how people learn in different settings and in different ways. Sociocultural analysis allows the study of learning at multiple levels, acknowledging that learning takes place in different timescales and in different settings. For example, individual learning could be studied whilst also recognising the social and cultural aspects, which play a part in that learning (Ludvigsen et al, 2011). Sociocultural methodologies allow the study of individuals over a period of time as they learn in a socially organised manner using tools to mediate the process.

Daniels et al (2007) have described sociocultural theory as a broad theoretical framework upon which there is not complete agreement amongst researchers. In their view there are several types of contemporary approach to sociocultural theory. In these approaches emphasis is placed upon different factors to analyse and research the sociocultural, historic and phylogenetic (how an organism changes over a longer period of time (Ludvigsen et al, 2011)) factors over a period of time. Emphasis may be placed upon semiotic mediation, the use of speech and other artifacts, used as tools which influence and develop thought and action, or on how people participate in communities or in activity theory, developed from sociocultural theory (Engeström, 1987), where the emphasis is on jointly mediated activities (Daniels et al, 2007). In all these approaches it is acknowledged that the person, the culture and their environment and how these affect each other cannot be separated into subjects, objects, independent or dependent variables for analysis

(Cole, 1996). This means that analysis of this type is suited to an interpretivist or constructivist approach and so fits the proposed research here.

The physiotherapy practice of clinical reasoning has evolved as a result of individual and group reflection on physiotherapy practice, starting as an activity embedded in social interaction and physiotherapy culture (Larsen et al, 2008). When starting to learn clinical reasoning, physiotherapy students rely on social interaction with others who may be lecturers, patients, placement educators or more experienced students. Through repeated and different social and learning experiences in the University or on placement, which expose the student to clinical reasoning the student will become more skilled in the process of clinical reasoning as a physiotherapist. The knowledge underpinning clinical reasoning will be socially constructed, internalised by the individual and transformed into new understanding and consciousness (Liu and Matthews, 2005). John-Steiner and Mahn (1996) argue that the power of Vygotsky's theory lies in his explanation of the dynamic interdependence between social and individual processes which characterise development, '*...the transformation of socially shared activities into internalised processes...*' (p3). Thus Vygotsky would conceptualise the development of clinical reasoning skills as the transformation of socially shared activity, which could be discussion between a clinical educator and student or participation in a case based wiki, into internalised processes which allow higher mental functioning and the ability to reason clinically as a competent practitioner (John-Steiner and Mahn, 1996). This process seems relatively straightforward at face value but the conditions under which the development of clinical reasoning skills happen is constantly changing in terms of the context of health professional practice. The context of practice may include factors such as social, political and professional policy, the economic and community context of local physiotherapy provision and local physiotherapy procedural and management structures (Ryan and Higgs, 2008). The transformation of a social process into an intrapersonal process such as clinical reasoning happens as a result of a long series of developmental events and so the process should be studied in its phases, in the university and clinical practice, and as it changes.

Vygotsky believed that semiotic mediation was key to the process of knowledge construction and acted to connect social and individual functioning (Wertsch, 1998). According to Vygotsky (1986), the tools of semiotic mediation include '*...language, various systems of counting, mnemonic techniques, algebraic symbol systems, works of art...*'(p137). The computer and virtual learning environments such as wikis are recognised as tools or semiotic means in contemporary sociocultural discourse (John-Steiner and Mahn, 1996). Knowledge about clinical reasoning is not

internalised directly but through the use of semiotic means or tools such as the wiki in this piece of research. The role of semiotic mediation was key to Vygotsky's research into the development of higher psychological processes and his view that the process of internalisation is transformative (Vygotsky, 1986). The concept of semiotic mediation was used by Vygotsky to explain how transformative internalisation occurred historically, ontogenetically (in this context, the study of the development of an individual's clinical reasoning) and microgenetically (in this context, the study of the same group of students over a short period of time) (John-Steiner and Mahn, 1996). The mediational means, the wiki in the context of this piece of research, are the key to link the development of the clinical reasoning of the pre-registration physiotherapy student to the physiotherapy culture and history of clinical reasoning. The wiki is an example of explicit mediation introduced by the module team into a learning experience to help develop clinical reasoning (Wertsch, 2007). Vygotsky's concept of semiotic mediation can be used to inform the methods used in this research. This means that the methods used for this research will study the students over a period of time, starting with information from the wiki itself before the students have entered clinical practice, talking to the students soon after they have entered clinical practice and again towards the end of their clinical practice as students, to develop a greater understanding of how their clinical reasoning has developed and how participation in the wiki may have affected this.

Vygotsky (1978) considered that higher mental functions, as they developed, were in a constant state of dialectical change. Dialectics has been referred to as the study of contradictions (Kvale and Brinkmann, 2009); as contradictions develop change and new knowledge occurs. John-Steiner and Mahn (1996) explain how Vygotsky used the dialectical notion of synthesis '*...to analyse, explain and describe interrelationships fundamental to human development where others posited dichotomies -- for example mind and matter... social and individual processes in the construction of knowledge.*' (p10). Vygotsky (1978) focussed on the interconnectedness of phenomena rather than their separateness and this along with the integration of opposites results in a synthesis of information within dialectics, that can lead to new or deeper understanding.

In this research, the methodology adopted could be classified as a historical, semi-longitudinal dialectical approach. The research methods chosen will allow the analysis of how the wiki affected the students' clinical reasoning development over a period of time and how the wiki is interconnected with both the theoretical and clinical parts of the physiotherapy course.

4.3. Research methods

The choice of research methods for this piece of research needed to reflect the qualitative paradigm and the constructivist approach taken, whilst at the same time being appropriate to the research question. The students' experiences of participating in the wiki and how this affected the development of their clinical reasoning were used to collaboratively construct a representation of how their clinical reasoning developed over time and how the wiki mediated this process. The methods chosen should also be coherent with the theoretical approach taken to the research and interviews, survey, textual analysis and observation are all examples of research methods which have been used in studies based on sociocultural theory (Ludvigsen et al, 2011). As Vygotsky (1978) stated:-

'To study something historically means to study it in the process of change...'(p65),

so to link the methodological approach to the research methods, this study followed a group of year two undergraduate pre-registration physiotherapy students as they finished the cardiorespiratory module which used a case based wiki to help develop their clinical reasoning skills and then as they moved on into clinical practice where further development of their clinical reasoning skills took place. Following a group of students over a period of time allowed the opportunity to study the process of change and development in their clinical reasoning skills (Daniels et al, 2007). Data from the participants was collected at three points:-

1. from a print out of the group wikis (referred to as wiki texts from here) completed before the students started their clinical placements
2. from focus groups and interviews with the students after they had completed one or two clinical placements
3. from follow up interviews with the students once they had completed at least three clinical placements

Data captured at different points in time allowed a construction of the development of the students' clinical reasoning capability from the point of view of the researcher and participants at the particular time that the data collection was carried out (Silverman, 2001). Specific time points for data collection were not chosen in this research, as it was recognised that the students' clinical reasoning capability would develop at different rates (Christensen, 2007), depending upon the learning experiences that the students were exposed to in terms of different clinical placements, different educators and so on. The important factor in the data collection was that it was

collected over a period of time. Collecting data at three points as the students developed their clinical reasoning also provided rigour to the study allowing cross checking of data through an iterative process. Interviews were combined with focus groups for data collection for pragmatic reasons to prevent the timing of sessions becoming an obstacle to participation in the research (Barbour and Schostak, 2005).

4.4 Participants

As this research aimed to increase understanding of how participation in a case based wiki affected the development of clinical reasoning in pre-registration physiotherapy students, purposive sampling was employed (Jongbloed, 2000). Participants were recruited from the students who had participated in and completed the TEL cardiorespiratory module. All second year students from the 2010 cohort of the BSc (Hons) Physiotherapy course (n=72), who had experienced the TEL cardiorespiratory module, were asked for permission to use their group wiki printouts for analysis. Volunteers were sought from the group of students, who agreed to their wiki printouts being used in the research, to participate in focus groups or interviews after they had completed one or two clinical placements and then follow up interviews after they had completed at least three clinical placements. Two focus groups took place consisting of three participants each, one in June 2012 and one in October 2012. The two other participants who were unable to attend the focus groups, took part in individual interviews in the initial phase of data collection. All eight participants took part in follow up interviews after they had completed at least three clinical placements. Table 4.1 shows the timing and order of focus groups and interviews with participants in relation to the number of clinical placements they had completed. All participants in the focus groups and interviews have been allocated pseudonyms and these are used throughout the thesis.

Participant	Order of research methods, focus group (FG) or interview (I)	Timing of focus group or interview one (Clinical placements)	Timing of interview two (Clinical placements)
Sheila	FG then I	June 2012 (1)	December 2012 (3)
Susan	FG then I	June 2012 (1)	December 2012 (3)
Sandra	FG then I	June 2012 (1)	December 2012 (3)
Sharon	I then I	August 2012 (1)	April 2013(6)
Sally	FG then I	October 2012 (2)	April 2013 (6)
Saskia	FG then I	October 2012 (2)	May 2013 (6)
Sarah	FG then I	October 2012 (2)	February 2013 (5)
Sonia	I then I	October 2012 (1)	May 2013 (4)

Table 4.1 to show timing and order of focus groups and interviews with participants.

As the students on this course complete the taught part of their course in the university prior to starting their clinical placements, they are on clinical placement which may be at some distance from the university for a year. The students returned to university for very short blocks between some placements and face to face data collection was limited to these periods. Inclusion criteria were any BSc (Hons) pre-registration physiotherapy student who participated in the TEL cardiorespiratory module in the 2011/12 academic year and was willing to volunteer to participate in the study.

4.4.1. Recruitment

Students were recruited during their first timetabled teaching session when all the students returned to the university in June 2012 after their first clinical placement. The researcher explained the purpose of the study to the students and sent a follow up email to the group. In the teaching session, students were asked to sign a consent form if they were willing for their group wikis to be used in the research (Appendix B). An information sheet about the focus groups and interviews was also distributed to the students at this stage (Appendix C) and students were asked whether they would like to volunteer to participate in the focus groups and interviews. The aim was to recruit up to ten students to participate in these, recognising the importance of the depth of data collected and that the sample represented the students who had participated in the module (Jongbloed, 2000). Eight students participated in an initial focus group or interview and a follow up interview. A ninth student volunteered to participate in the study but withdrew from the study due to illness before any data collection took place.

4.5. Ethics

Tier one ethical approval was given for this piece of research by the Institution Faculty of Education and Sport Research Ethics and Governance Committee (Appendix A). This research adhered to the British Educational Research Association's (BERA) guidelines for educational research (BERA, 2011) and the Institution's Guidance on Good Practice in Research Ethics and Governance (2010). The main ethical issues raised by this study were informed consent, confidentiality and anonymity and the power relationship between the researcher and the participants. Consideration will be given to each of these points.

For participants to give informed consent, they need to have a full understanding of the research and consequences to themselves for taking part (Piper and Simons, 2005). The researcher explained the purpose of the research to the students during a classroom session. Any questions or concerns the students raised about participating in the research were discussed with the

researcher. Those students who allowed the print outs from their wiki to be used and those taking part in the focus group and interviews were volunteers who signed a consent form detailing what would be asked of them in taking part in the research. The students had to actively volunteer to participate in the study by asking for and signing a consent form or responding to an email and were not coerced or given incentives to participate.

Confidentiality in the process of conducting research is recognised as an important principle in educational research (BERA, 2011). The principle of confidentiality allows participants to speak in confidence during the research process, whilst that of anonymity offers some protection against their identification when the research is reported (Piper and Simons, 2005). In relation to this study the data collected were immediately transferred to and held securely on password protected computers. Data was then deleted from recording devices. Any hard copy information such as signed consent forms were kept in locked filing cabinets. In the focus groups and interviews, ground rules about confidentiality were established (Barbour and Schostak, 2005) and students were asked to focus on their own experiences of developing clinical reasoning skills in relation to the wiki to try and avoid breaches of confidentiality in relation to other students on the course. If a student had disclosed anything untoward about their clinical practice, their behaviour or that of another student, the researcher would have discussed any further action with her supervisors. The only people with access to the data were the researcher and her supervisors and the data collected for analysis was anonymised by allocating a pseudonym to each student participant to try and avoid identification in any write up.

The researcher is a lecturer and therefore held a position of implied or unequal power in relation to the students who decided to participate in the study. Every attempt was made to ensure that consent was freely given by the students and that the research design considered and minimised any risks of harm to the participants (Forwell, 2000). The relationship between lecturer and students could have had a bearing on recruitment of participants into the study as students may have hoped that by volunteering for the study, they would be treated more favourably in future assessments by the researcher for example. The researcher was clear in presenting the research to the students that her position as a researcher was separate to that of a lecturer. The researcher was not involved in any future assessment or examination boards of the year group from whom the students who participated in the study were recruited. The researcher's involvement as a lecturer with this group of students finished at the end of the TEL cardiorespiratory module in March 2012.

The risk of harm to the participants in this study was considered to be minimal, however in line with research procedure in the School in which the research was being carried out, a colleague of the researcher was available each time a focus group or interview took place. This was in case a participant became upset by the discussion taking place and if this had occurred, the discussion would have been stopped and the participant would have been given the opportunity to leave the room and discuss their concerns with the researcher's colleague.

Carpenter and Hamell (2000) have also suggested that conducting interviews in an interactive manner and conducting sequential interviews may improve reciprocity between the researcher and participants and in doing so, go some way to reducing the power imbalance between the two. In this research the researcher tried to carry out the interviews in an interactive manner and interviewed each participant on two occasions. All these decisions were taken to try and minimise the influence of any power relationship between the participants and the researcher in this research.

The researcher could also be considered as an insider in the group with whom the research was being carried out. The researcher had participated as a facilitator in the wikis which are the subject of the research and taught the students in the year group. During focus group and interview discussions students may have discussed information about other students within their cohort about inappropriate behaviour for example. The highest priority was given to the focus group discussions remaining confidential and students were asked to focus on their own development of clinical reasoning skills and any part the wiki played in this.

4.6. Data sources

4.6.1. *The wiki texts*

Wiki texts from groups of students whose members included participants in this research were used as a data source in this research. These were considered as texts which could offer a deeper understanding into the development of the student's clinical reasoning and the part played by the wiki in this, before the students went on clinical placement. Although the wikis were saved at the end of the module, the process of development was captured in these because we asked students to comment in the wikis as they engaged in thinking about treatments for patients in the cases. The wiki texts allowed comparison with other literature in the field (Christensen, 2007; Hendrick et al, 2009; Cruz et al, 2012) by assigning clinical reasoning and metacognition codes taken from the literature to segments of data within the wikis (Murphy, 2004; Tan et al, 2010). This information could then be synthesized with the data collected in the interviews to develop a

deeper understanding of the students' development of clinical reasoning. Using the wiki texts as a basis for data capture helped to provide rigour to the study allowing cross checking of data through an iterative process as the students moved into clinical practice and developed their clinical reasoning skills further.

4.6.2. Focus groups and interviews

A combination of focus groups and interviews was used in this research to collect data. This was because data collection was limited to short and specific times when students were in the university between clinical placements or on clinical placement close to the university so that they could attend the university for data collection. Using both focus groups and interviews as research methods in this research allowed those who could not attend focus groups to participate in the research (Barbour and Schostak, 2005). This meant that an appropriate sample size was recruited for the research and an adequate amount of data was available to be analysed to inform the answers to the research questions (Morse and Field, 2002). It is acknowledged that there can be important distinctions between focus groups and interviews as methods of data collection (Braun and Clarke, 2013) thus there were advantages and disadvantages to using both in this research. These points will be considered in the following section.

4.6.2.1 The focus groups

A focus group normally consists of seven to ten people who have been recruited purposively (Greenbaum, 2000) and can be thought of as a social process, specific to a particular context – the time, place and the participants in the group, who co-construct an account of their ideas in relation to a particular topic (Barbour and Schostak, 2005). The focus groups in this research only consisted of three people, a much smaller group than that recommended by Greenbaum (2000). Fern (2001) suggested that the size of focus groups which are used in practice, may be declining to as few as two members in some instances and suggests that the researcher's goals may be more important to determine the size of the group rather than practice norms. In this research, the use of small focus groups allowed all participants voices to be heard and had the advantage of allowing students to think about and reflect on others' comments about clinical reasoning before contributing to the discussion. This was important in the initial interviews because clinical reasoning was still a 'slippery concept' for some of the students at that time. Where participants have less to say about the topic of discussion (clinical reasoning), it is possible that the researcher, who has more experience in the topic could lead the participant rather than listen to their comments and so miss important information.

The other reason why a focus group seems particularly appropriate to this piece of research is that the students had been working collaboratively to construct meaning in their wiki groups, so it is a similar process albeit in the face to face situation with which they have some familiarity. The focus group gave the opportunity for students to co-construct a representation of the experience of the development of their clinical reasoning and how the wiki affected this with the researcher and also gave insight into the social processes that contribute to this rather than leaving the researcher to interpret individual views as would have been the case if only individual interviews were used at this stage. There is a danger that by using focus groups, the views of some individuals may be lost as the focus group may produce a conformity of view about the topic from those within the group (Sim, 1998). Using follow up interviews allowed students to express their own thoughts and views about the research topic.

Other important points must be considered when deciding whether to use focus groups as a research method. Power relationships must be considered and they are very important here because the researcher and focus group moderator is a lecturer of the students. It was clearly stated that students could choose whether they wished to take part in the focus group and that the researcher would not be further involved in the assessment of the students who took part whilst they were on the course. It was a key part of the process to establish trust within the group. There may have been other power structures at play amongst the focus group participants as they were all known to each other and part of the larger year group of physiotherapy students where each student would already have a relative social position (Barbour and Schostak, 2005). Bringing a group of students together, even though they already know each other, for research purposes may mean that the students cross boundaries that they would not normally do in everyday life. For this reason, it is important to emphasise confidentiality as a basic ground rule in the conduct of the focus group.

4.6.2.2 The interviews

An interview is a directed conversation that allows an in depth exploration of a particular topic (Charmaz, 2006), in this case the development of clinical reasoning from the participant's point of view and the influence that participating in a case based wiki has had on that. The resulting data is a construction of reality from the point of view of the participant at the particular time that the interview was carried out (Silverman, 2001). Thus interviewing as a method could be criticised in this study because the aim is to explore the development of the participants' clinical reasoning over a period of time. Stark and Torrance (2005) argued that the researcher should use the interview to look beyond the here and now and use it to gain an insight into participants'

memories and explanations of why things are as they are, so each interview can be used to capture development. Repeating interviews over time should also capture development.

Kvale and Brinkmann (2009) described the researcher as the tool of his or her own research and so interviews can be utilised and adapted in different ways to elicit different types of information. In this research eliciting meaning about clinical reasoning development and a rich description of how this had occurred and been influenced by the wikis were key features of the interviews. This meant that the researcher attempted to listen to descriptions and meanings expressed by the participant and reflect back their interpretation to reach an understanding of the participant's meaning (Kvale, 2007). The researcher attempted to obtain rich data by allowing the participant to describe, reflect upon and interpret their experiences of the research topic whilst also probing in an interested manner and showing a desire to know more. The interviews in this research were loosely semi-structured. A basic question guide was devised for both the initial and follow up interviews (see Boxes 1 and 2 below) to focus these but the researcher tried to allow the participant to do most of the talking, using prompts to increase the richness of the data. The interviews both collected and constructed knowledge (Kvale and Brinkmann, 2009) with the participants and therefore fit with the constructivist approach of this research.

Box One: Initial focus group and interview question guide

How would you define clinical reasoning?

Tell me about when you first became aware of the term 'clinical reasoning'

Did it seem important as a concept for professional practice – why?

How did your thoughts about clinical reasoning develop through the taught part of the course?

How have they changed since you've been on placement?

How did participation in the wiki affect your development of clinical reasoning?

How was this compared to other areas of the taught part of the course?

Is there anything else you want to say about clinical reasoning or the wiki?

Further development of the interview schedule occurred as the interviews progressed. Analysis of the initial interview and focus group data took place prior to the follow up interviews. This allowed findings from preceding interviews to be explored further in the follow up interviews.

Box Two: Follow up interview question guide

Tell me your thoughts about clinical reasoning now. How would you define clinical reasoning now?

How have your thoughts about clinical reasoning changed since the last interview?

Why? Can you tell me more about how you think this happened?

How have the different parts of the course contributed to this?

Discuss emerging points from analysis of the first interviews about how wikis may have helped develop clinical reasoning eg. focus on patient, working together, discussion, finding and using information.

Is there anything else you want to say about clinical reasoning or the wiki?

4.7. Data collection process

Two wiki groups which contained students who had given their consent to allow their wiki pages to be used in the research and students who had volunteered to participate in the focus groups and interviews were identified from the student cohort. The wiki pages of these groups were downloaded and saved to a password protected computer for analysis.

The focus groups and interviews took place at a prearranged time that was suitable for both the students and researcher in a room at the university, during a period when the students were back in the university from clinical placement. Students were asked to sign a consent form prior to participation in the focus group or interview which gave their consent to take part in the focus group and the follow up interview (Appendix D). The focus groups were audio recorded and transcribed verbatim. The follow up interviews took place at a mutually convenient time in a room at the university and were audio recorded and transcribed verbatim. The researcher completed reflective fieldwork notes about the process immediately following the focus groups and interviews.

4.8. Data analysis

In this study sociocultural analysis was used to analyse the social processes and internalisation of the development of clinical reasoning skills in pre-registration physiotherapy students by examining and synthesizing the social and individual processes in the construction of this process

in relation to physiotherapy culture. Ludvigsen et al (2011) stated that the process of learning should be studied at multiple levels, especially when the learning takes place along different timescales and in different settings, as is the case in this research. To develop a process for data analysis, a conceptual framework was developed which linked factors to be considered in a sociocultural analysis based on Vygotsky's (1978) theory to my study. Figure 4.1 shows my initial conceptual framework of the shape of the data analysis based on Vygotsky's sociocultural theory. Miles et al, (2014) state that a conceptual framework contains and explains the main things to be studied and that the framework will change over time. The whole diagram represents a student's time on the physiotherapy course from left to right. The red boxes represent the individual factors that may affect a student's clinical reasoning development, the orange the social factors and the green the cultural factors. The boxes surrounded by dashed black lines are the focus of the research and can be related to sociocultural theory to show how transformative internalisation occurred in relation to clinical reasoning historically, ontogenetically and microgenetically (John-Steiner and Mahn, 1996). The data was analysed in the order shown in the diagram, using the phases of thematic analysis described by Braun and Clarke (2006).

The rationale for this choice of data analysis and how it fits with sociocultural theory is explored in more detail below. My starting point for data analysis was this framework with my research sub-questions:-

What does the pre-registration physiotherapy student understand by clinical reasoning?

What is the process of development of clinical reasoning from the pre-registration physiotherapy students' perspective?

What contribution does the case based wiki make to the development of clinical reasoning skills from the pre-registration physiotherapy students' perspective?

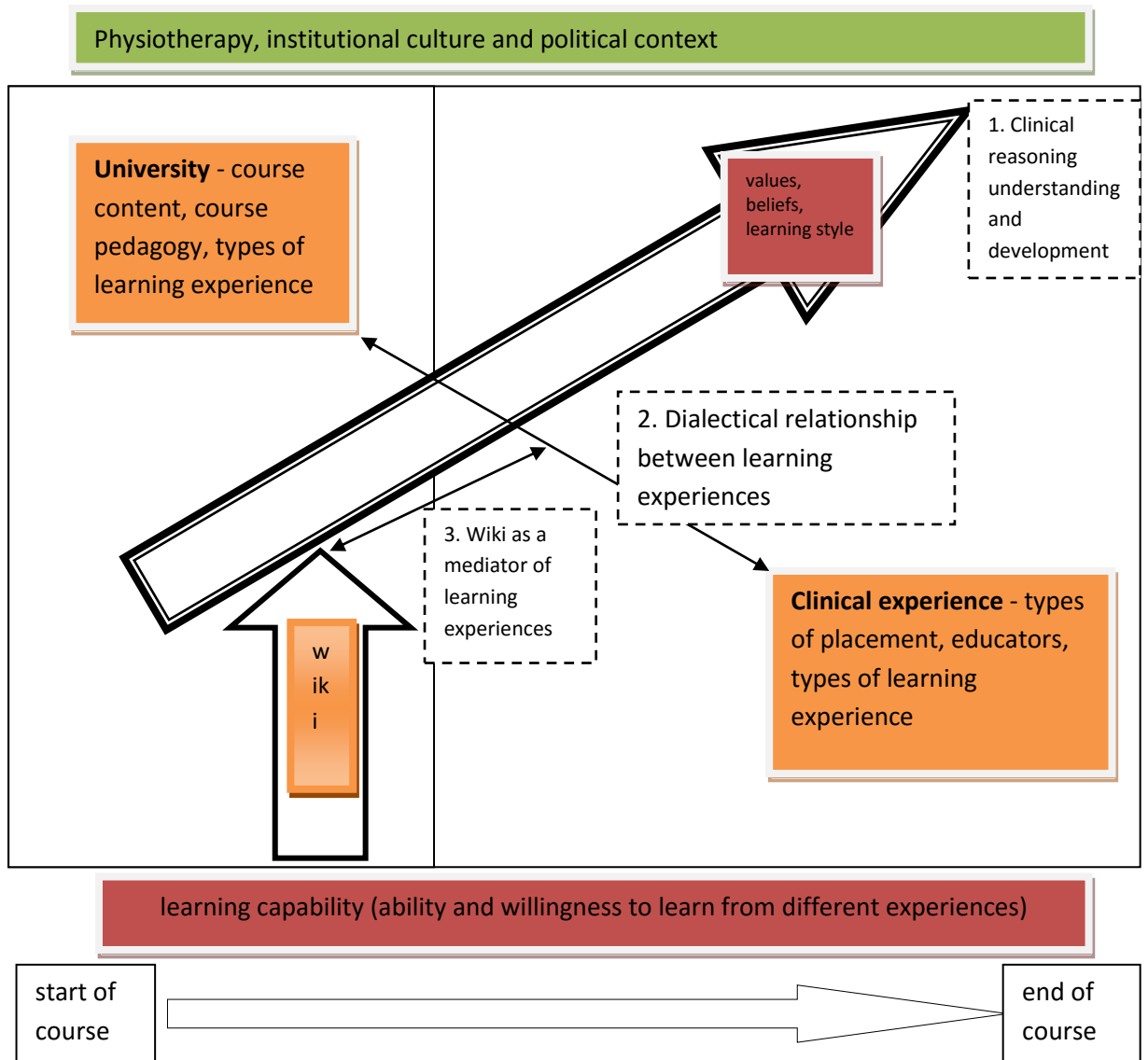


Figure 4.1 to illustrate my conceptual framework of the shape of the data analysis based on Vygotsky's sociocultural theory.

4.8.1. Thematic analysis

The approach to finding meaning in the data was based on thematic analysis as defined by Braun and Clarke (2006):

'...a method for identifying, analysing, and reporting patterns (themes) within data. It minimally organises and describes your data set in (rich) detail. However, it also often goes further than this, and interprets various aspects of the research topic...' (p6)

Braun and Clarke (2006) are of the opinion that thematic analysis can be considered as a methodology in its own right but that the term has been used to describe qualitative analysis without rigour and clear boundaries. However, they also believe that thematic analysis can be used rigorously and in studies underpinned by different theoretical frameworks. Boyatzis (1998) stated that thematic analysis is the first analysis technique that qualitative researchers should learn because it underpins many other types of qualitative analysis. Braun and Clarke (2006) believe that thematic analysis can be used across a range of research paradigms to give a detailed, rich and complex account of data. As thematic analysis is carried out, the choices the researcher makes should be explicitly stated and supported by a reflexive account of the analysis (Finlay and Gough, 2003). Thematic analysis can be used inductively or theoretically, (Braun and Clarke, 2006). In this research thematic analysis was used inductively initially and then theoretically so that the final synthesis of coding mapped onto the specific foci identified in my conceptual framework (Figure 4.1), clinical reasoning understanding and development, the dialectical relationship between theoretical and clinical learning experiences and how the wiki impacted on and mediated these experiences. Separate thematic analyses were carried out for each stage of the data collection, the wiki texts, the initial focus group and interview transcripts and the final interview transcripts. Once these separate analyses were carried out, the data was synthesised to provide a greater understanding of the process by which physiotherapy students develop their clinical reasoning using a case based wiki.

Braun and Clarke (2006) describe six phases of thematic analysis as illustrated in table 4.2 below. These processes were followed in analysis of the data set, the wiki texts and the interview and focus group transcripts.

Phase	Description
1. Familiarise yourself with the data	Transcribe, read and re-read data. Note down initial ideas.
2. Generate initial codes	Code data in a systematic manner across the whole data set. Collate data relevant to each code.
3. Search for potential themes	Collate codes into potential themes and collate data relevant to each theme.
4. Review themes	Check the themes work in relation to coded extracts and the whole data set. Generate a thematic representation of the analysis.
5. Define and name themes and link to theoretical framework.	Define and name each theme through the overall story the analysis tells.
6. Produce the report	Final opportunity for analysis by selecting extracts to illustrate examples. Relate these back to the research question and literature.

Table 4.2 The six phases of thematic analysis adapted from Braun and Clarke (2006) (p35).

4.8.2. Other analyses of the wiki texts

Prior to analysing the wiki texts thematically, it was important to provide a description of the shape of the data set to contextualise the thematic analysis. This meant that the wiki texts were subjected to further forms of analysis to comprehend and evaluate the data. This information was later synthesised with the interview data to allow theoretical consideration and recontextualisation of the data (Morse, 2004) and comparison with the literature. Two wiki texts were used as part of the data set in this research. Each text covered all six patient cases and included the treatment grids and comments associated with these. Each text came from wikis from a group of students whose members included participants in the interviews and focus groups. As there were nine wiki groups in the year group and only two were included in the analysis, it seemed important to determine whether all the students in each group had contributed to the wikis, the contribution of the interview participants and whether there was any pattern in the number of comments attached to each wiki case for example, as the students became more familiar with the process.

Next the texts were analysed to identify elements of critical thinking in the comments sections of the wikis using an instrument designed to support analysis of critical thinking in online asynchronous discussions, which was developed by Murphy (2004) and modified by Tan et al (2010). This instrument was chosen because it was developed following a thorough review and synthesis of four critical thinking models, which identified key factors and processes associated with critical thinking that were then developed into the instrument. The four models used in the

development of the instrument were two based on computer conferencing, developed by Bullen (1998) and Garrison et al (2001) and two models which focussed on critical thinking in the theoretical context of teaching and learning, developed by Brookfield (1987) and Norris and Ennis (1989). The instrument developed by Murphy (2004) was subsequently tested in an online asynchronous discussion of pre-service second language teachers and was shown to demonstrate behaviours related to critical thinking (Murphy, 2004). Murphy's instrument (2004) contained 25 descriptors relating to the processes of recognise, understand, analyse, evaluate and create and the sentence was used as the unit of analysis in her study. For the purposes of this study, the indicator codes in the categories were not used because the aim of using the instrument was to give an overall description of the data. In this study, the comment was used as the unit of analysis. Table 4.3 illustrates the instrument used to support the analysis of critical thinking skills in the wiki texts. Not only is the instrument used in this study (Table 4.3) based on theoretical models of different types of critical thinking (Murphy, 2004) but it also has a strong link to the thinking which occurs when a physiotherapist assesses and treats a patient, as well as taking into account different perspectives of the patient and other members of the multidisciplinary team. This instrument therefore seemed well suited to giving an overall description of the data.

Critical Thinking Process	Descriptor	Code
Recognise	Recognising or identifying an existing issue, dilemma or problem.	CTR
Understand	Exploring related evidence, knowledge, research, information and perspectives.	CTU
Analyse	Seeking in depth clarification, organising known information, identifying unknown information and dissecting the issue or problem into its component parts.	CTA
Evaluate	Critiquing and judging information, knowledge or perspectives.	CTE
Create	Producing new knowledge, perspectives or strategies.	CTC

Table 4.3 to illustrate the instrument used to support the analysis of critical thinking skills in the wiki texts, derived and adapted from Murphy (2004) (p5).

The wiki texts were then analysed for evidence of clinical reasoning. Where clinical reasoning was identified in the texts, this was further categorised into specific types of reasoning, which are shown in the table 4.4. This analysis strategy was based upon that which was used by Tan et al (2010). Their research attached clinical reasoning codes to blogs which undergraduate and physiotherapy students participated in whilst they were on clinical placement. As our students were using wikis in the taught part of their course prior to clinical placement, and were using

paper cases upon which the wikis were based, they did not have feedback from a patient as a therapist would in practice. Therefore types of clinical reasoning such as collaborative reasoning (Edwards et al, 2004) and interactive reasoning (Fleming, 1991), which rely on communication with the patient, could not be considered in the analysis of the wiki texts. The paper cases did contain a description of the patient's circumstances, so that the students could give consideration to these in the wikis. Therefore the decision was made to define a category called 'patient centred reasoning' in the analysis to show where students had considered the patient's circumstances in their reasoning. Table 4.4 shows the clinical reasoning codes which were applied to the wiki texts.

Clinical Reasoning Type	Definition	Code
Diagnostic reasoning (Edwards et al, 2004)	Collective term for hypothetico-deductive reasoning Investigates patient's disability and related impairments, pain mechanism, pathophysiology and contributing factors to dysfunction	DR
Procedural reasoning (Mattingly and Fleming, 1994)	Making decisions in treatment	PR
Ethical reasoning (Edwards et al, 1998)	Reasoning of any ethical dilemmas which would affect how an intervention was carried out, the desired treatment goals and suggestions for resolving these	ER
Patient centred reasoning	Reasoning where the patient's circumstances are considered in treatment	PCR

Table 4.4 to illustrate clinical reasoning codes applied to the wiki texts derived and adapted from Edwards et al (2004) and Tan et al (2010) (p360).

These analyses of the wiki texts provided evidence of the types of thinking and reasoning that the students were carrying out in the wikis and how this linked to their overall development of clinical reasoning. As the analysis progressed, it became clear that this was an important step in the research and analysis because it seemed that students were carrying out types of clinical reasoning in the wikis that they may not have recognised as clinical reasoning at that stage in their clinical reasoning development. Apart from providing a richer description of the data, these analyses also provided a method to confirm the rigour of the study by triangulating the information obtained from the wikis with that of the interviews to confirm how the students considered their clinical reasoning developed by using the wikis. Further discussion of the analysis process will be considered alongside the results in chapter five as the analysis developed.

5. Chapter Five: Findings

Chapter five presents the findings of this research. In order to develop an understanding of how the wiki influenced the development of clinical reasoning capability in this group of students, it was first necessary to understand how the students' clinical reasoning developed through the course, during both the theoretical part of the course and their clinical placements. An initial analysis of the wiki texts was undertaken to contextualise their thematic analysis. Data from the wiki texts, focus groups and interviews were then thematically analysed, aligned to Vygotsky's sociocultural theory (Vygotsky, 1978) and synthesised to illustrate the change in students' clinical reasoning capability over time. This allowed identification of what the students understood about clinical reasoning as their clinical reasoning developed, identification of important factors in the process of appropriation of clinical reasoning capability in this group of students and an understanding of how the introduction of the wiki as an explicit mediator influenced the development of their clinical reasoning capability, thus answering the research questions for this thesis. The results of separate analyses are presented individually, followed by a synthesis of the separate analyses with supporting information about how the analysis developed as the process was carried out.

5.1. Analysis of the wiki texts to contextualise their thematic analysis

The overall shape of the data in the wiki texts was considered for critical thinking, clinical reasoning, the number of comments in each wiki text and which members of the wiki groups made the comments. Table 5.1 illustrates the number of comments in each wiki text for each wiki case. This table includes the tutors' feedback comments. The number of comments by each group for each case is very similar, with more comments attached to the first case and less for the last. This may indicate both increasing familiarity with using the wikis and with the process of developing problems, treatments and supporting literature for the patient cases.

Wiki Case	1	2	3	4	5	6	Total comments
Number of comments wiki group one	20	13	13	13	11	7	77
Number of comments wiki group two	20	15	15	13	12	8	83

Table 5.1 to show the number of comments in each wiki text for each wiki case.

All the students in both wiki groups contributed to their wikis, although there was a large variation in the number of contributions. In both groups there was one student who made a significantly larger contribution than the others, whilst two students in wiki group two only made one or two contributions throughout the whole module. Those students who made the largest contributions in both groups posted almost twice as many comments as the second largest contributor in each group. This could indicate a major role in scaffolding the other students learning. Table 5.2 shows how many comments each student made in each wiki group throughout the module. The total boxes represent the total comments made by the students in the wikis in the module. Tutors were therefore responsible for 16 and 11 feedback comments in the process for wiki group one and wiki group two respectively. Qualitatively the comments in the wikis all consisted of whole sentences which made a clear statement about the cases. There were no single word comments, which may indicate that students were engaging with the learning task and showing others in their group that they were doing something towards the learning task. Both these preliminary analyses showed some consistency and similarities between the two groups and gave some context for the clinical reasoning, critical thinking and thematic analyses of the wiki texts.

Participant	A	B	Saskia	D	E	F	G	Total
Wiki Group One	10	5	20	8	4	8	6	61
Participant	Sheila	I	J	K	L	Susan	N	Total
Wiki Group Two	11	2	29	4	10	15	1	72

Table 5.2 to show number of comments made by each student in the wikis throughout the module.

The pseudonyms allocated to the participants in the table are consistent throughout the data analysis. Names rather than letters have been allocated to those students in the groups who also

took part in the focus groups and interviews. Verbatim quotes are followed by 'WG1' or 'WG2' to show which wiki group the students were in. Three tutors gave feedback in the wiki texts and all are referred to by 'tutor' in the data analysis where their names were used by the students in the wiki texts. The quotes taken from the wiki texts have been used as the students wrote them.

5.2. Types of critical thinking identified in the wiki texts

Table 5.3 presents the results of the critical thinking analysis based on the instrument developed by Murphy (2004). The table shows how many occurrences of each type of critical thinking process there were in each comments section of each wiki. Again there is some similarity in the number and spread of the critical thinking processes identified in both wikis.

Critical Thinking Process (and code)	Descriptor	Wiki one	Wiki two	Total
Recognise (CTR)	Recognising or identifying an existing issue, dilemma or problem.	1	1	2
Understand (CTU)	Exploring related evidence, knowledge, research, information and perspectives.	31	23	54
Analyse (CTA)	Seeking in depth clarification, organising known information, identifying unknown information and dissecting the issue or problem into its component parts.	20	18	38
Evaluate (CTE)	Critiquing and judging information, knowledge or perspectives.	32	28	60
Create (CTC)	Producing new knowledge, perspectives or strategies.	6	0	6

Table 5.3 to show the number and type of critical thinking processes identified in the wiki texts.

There were only two instances of the construct 'recognise' in the comments sections of the wikis. This may be because the learning task required the students to identify problems for the patient cases and identify appropriate treatments for these, which were reported in the grid section of the wikis. All of the wiki grids therefore contained problems which the students had identified for the patients. The two instances of recognise were used where students had recognised a problem which they did not understand and were asking for help from the group:-

'surely if the patient is sedated we won't be able to do percussion and vibrations with them? Because they would need to breath in and out - or can you? I'm really confused' F, WG1

'I've updated the problem. I'm a little confused whether we need to continue using the good lung down process based on Tutor's comment. Anyone know why we wouldn't use that?' J, WG2.

These instances could fit into the category of 'understand' which with the category of 'evaluate' produced the highest number of critical thinking processes identified in the texts. For this group of students, part of their learning was about understanding and exploring known information in existing texts. This is reflected in comments related to the understand construct such as:-

'First entry for Case 1, sources: Prasad & Pryor, lecture notes etc. Please add any thoughts/suggestions. Thanks,' B, WG1

'Also found this article - Prevention of respiratory complications after abdominal surgery: a randomised clinical trial

<http://www.bmj.com/content/312/7024/148.abstract>

but i think its for without complications so not sure how relevant it is.' A, WG1

'...I've added the cardiac rehab bit..I will read the chapter on it later and add the clinical reasoning. Feel free to rearrange the exercises, I tried my best to put them into a progressive order but its subject to change.' Sheila, WG2

The learning task associated with the wiki encouraged students to evaluate each other's comments and suggestions to come up with the best treatment for the patient case, as well as explore the evidence related to their treatment suggestions to try and find suitable evidence to support their suggested treatments. The highest number of critical thinking processes identified in the texts fell into the 'evaluate' category. This gives some support to the effectiveness of the use of the wiki in the learning task to produce the intended outcomes. The effectiveness of the wiki in producing 'evaluate' comments may also be attributable to the structure of the wiki. Newton Scanlon and Hancock (2010) found that more examples of evaluation were found in occupational therapy students' blogs, used to promote clinical reasoning, when a structured framework was introduced to guide discussion, compared to previous unstructured use of the blogs for the same task (Newton Scanlon et al, 2006). Examples of comments which show evaluation of other students comments in the wiki texts include:-

'Xs comments mentioned lower lobes were done by gravity, but i assume for ACBT we would treat the whole lungs so that would use both gravity and the positions, i've only mentioned the positions in this section of clinical reasoning not gravity as it's already mentioned above.' A, WG1

'I have added to X 's input on ACBT. I found an article (which i have posted in the evidence exchange)on patients preferring a horizontal drainage position however this may vary for Sean and the appropriate drainage position for him would need to be assessed.' D, WG1

Many of the 'evaluate' comments supported the notion that students were engaging with and discussing relevant literature within the wiki:-

'I have added in the article that we looked at about the different techniques. Im not sure how to write it into our treatment as essentially its about which treatment we would use on Sean as none of them are better than the rest.' F, WG1

'Also removed the other article(Gillespie) for positioning as study group did not include anyone who was sedated so the article was not suitable for our inclusion criteria.' J, WG2

'Closed tracheal suctioning system for prevention of ventilator associated pneumonia. This is a meta-analysis on 9 RCT's comparing closed and open suctioning in mechanically ventilated (MV) patients and pneumonia induced by MV. Their conclusion was that there was no difference for use in reference to mortality or ICU length stay. However, closed suctioning was associated with longer MV duration and higher colonization of the respiratory tract (which may help us ascertain why we would use open suctioning).

Am looking within the meta-analysis now to pick up a particular study for our use.' Susan, WG2

Murphy (2004) found fewer examples of the 'analyse' construct in her application of the critical thinking instrument to an online asynchronous discussion of student foreign language teachers. 'Analyse' accounted for 15% of the total constructs identified in her study. She attributed this to the relevance of analysis to the task but highlighted that a low representation of a particular construct from using the instrument could indicate that the learning task requires adjusting to produce the desired result. Detailed analysis of information such as assessment and treatment results is an important skill for physiotherapy students, so the higher representation of instances of 'analysis' in the wiki texts (26% of the total constructs identified), indicated that students were starting to develop these skills. Examples of instances of 'analyse' include:-

'I think the first box with the ACBT and manual techniques need to be more detailed in clinical reasoning so if people want to add more info that would be good. And to say exactly the cycle we would do in the treatment box.' D, WG1

'Mr H is SOBA which is why I have suggested that there be an emphasis on the controlled breathing element of ACBT, combined with forced expiration (keep the breaths in short, and huffs out longer, because patient is short of breath) to help remove the secretions.' Saskia, WG1

'Just modified the deep breathing section. To include an inspiratory hold and subsequent clinical reasoning.' Susan, WG2

The 'create' construct only produced six instances in the comments section of the wiki text. Instances of 'create' were identified where a student had synthesised information about a case including the patient's circumstances to explain their suggestion of suitable treatment for that case. Synthesising this information to suggest a suitable treatment could be considered as

producing new knowledge for the students. In contrast to this use of the instrument, the analysis reported by Murphy (2004) contained no instances of create because those students had not put their ideas into practice as the online discussion took place in a theoretical module. As the students in the module under consideration in this research, were putting their ideas into practice in skills practice and assessments, 'create' was considered to be a suitable construct to assign to the following comments:-

'Our position is a modified version of what should really be a tip I think for the lobe segment we are trying to treat, tipping would be contraindicated for this pt cos she has been admitted with fits, which is unexplained but caused by something blocking or damage in the brain.' Saskia, WG1

'Looking back at Sean's history would help indicate if this big change (going to university) in Sean's life could be an indicator for these exacerbations or has he always suffered with these periods of infection.' Saskia, WG1

'With regards to the ACBT cycle prescription, we are focusing on a palliative care approach and so it should be patient centered, in other words our prescription is suitable and justified but it should still be patient led and adapted to suit them, she is frail and so the likely reason for stopping treatment would be fatigue.' Saskia, WG1

It should also be noted that the instances of 'create' which were identified in the comments section of the wiki texts came from the same student who appeared to play a significant role in scaffolding the students' learning within the wiki group. Other instances of 'create' occurred in the treatment grids of the wikis where suitable treatment for each patient case was produced by the group.

This analysis illustrated that there was evidence of critical thinking being demonstrated within the wikis and that students were using skills which have been shown to be important for clinical reasoning development (Christensen, 2007; Brudvig et al, 2013). Although the critical thinking instrument was used in a different way to that of Murphy (2004) because only the broad descriptors were used for each category and the comment was used as the unit of analysis, the instrument appeared to be useful for describing the kind of critical thinking skills which the students were using in the wikis and to give some context for the thematic analysis.

5.3. Types of clinical reasoning identified in the wiki texts

The learning experience in this module asked students to describe and articulate the underpinning clinical reasoning for their treatment choices for the patient cases in the grid section of the wiki. Learning about clinical reasoning was thus embedded into the module. Although there was evidence of clinical reasoning in the wiki grids, it was important to define the kinds of clinical

reasoning which students were carrying out to contextualise the thematic analysis in this research and for comparison with other literature in this area. It has been suggested that novice practitioners, for example students who are new to practice, are heavily reliant on hypothetico-deductive reasoning and much less likely to consider patient's wishes and circumstances in their reasoning (Hendrick et al, 2009; Tan et al, 2010). An analysis of the types of clinical reasoning which were present in the wiki texts was undertaken using definitions of different types of reasoning adapted from Tan et al (2010). Tan et al (2010) had used these clinical reasoning codes to analyse blogs written by physiotherapy students who were on clinical placement. In this research, the whole wiki texts were analysed, both grids and comments section for types of reasoning and the unit of analysis was the comment. Table 5.4 illustrates the types of clinical reasoning which were evident in the wikis.

Type of reasoning	Descriptor	Number in wiki texts
Diagnostic reasoning (mostly from wiki grids)	Collective term for hypothetico-deductive reasoning Investigates patient's disability and related impairments, pain mechanism, pathophysiology and contributing factors to dysfunction	26
Procedural reasoning	Making decisions in treatment	34
Patient Centred reasoning	Reasoning where the patient's circumstances are considered in treatment	37
Ethical reasoning	Reasoning of any ethical dilemmas which would affect how an intervention was carried out, the desired treatment goals and suggestions for resolving these	1

Table 5.4 to show the types of clinical reasoning students used in the wikis.

Although the students were not able to collaborate with and gain feedback from the patients about treatment choices, the highest number of comments were related to patient centred reasoning, a category defined to show where the students had considered the patient's circumstances in their reasoning. Based on previous research (Tan et al, 2010; Hendrick et al, 2009) and the fact that the patient cases only gave very brief details about the patients' circumstances, this was somewhat surprising. The students had linked their clinical reasoning specifically to the patients in the cases, for example:-

'Miss Taylor will be fully sedated so will unable to independantly perform a cough. She will not be able to remove the secretions from the pneumonia thus making it difficult for her to oxygenate.'
Grid, WG1

'In addition to postural drainage, I thought that exercise would be a good component of treatment for Sean given his age. With the guidance of his physiotherapist, exercise is something he could do on his own. I am thinking this would help him to feel more independent and in control of his treatment.' Sheila, WG2

Procedural reasoning had the second highest representation in the wiki texts. Procedural reasoning has been defined as making decisions in treatment (Jones et al, 2008). As the learning task in this module required students to make decisions about treatment for the patient cases, this should have accounted for a substantial proportion of the clinical reasoning which occurred in the wiki. Examples of procedural reasoning include:-

'Not sure who has added the muscle strengthening exercises but not sure this would be necessary at this point ... whoever did it please could you expand to give some context.' J, WG2

'I've added forward lean sitting & pursed-lip breathing. These were both used and proved successful to help another female patient of 62 years with stage IV non- small cell lung cancer to manage her dyspnea.' L, WG2

'After reading the comments do you think we should put the part about V/Q matching as a separate problem and incorporate the SOB into that?' A, WG1

These examples show that the wiki was used by students to interact in a meaningful manner to practice making decisions in treatment.

Apart from ethical reasoning, diagnostic reasoning had the smallest representation of clinical reasoning types in the wiki texts. As diagnostic reasoning has been defined as a collective term for hypothetico-deductive reasoning by Jones et al (2008) and novice practitioners are heavily reliant on this type of reasoning (Tan et al, 2010; Hendrick et al, 2009), it may have been anticipated that this would have had the highest representation of types of clinical reasoning in the wiki texts. In a normal patient encounter, a physiotherapist would have some kind of referral with a very small amount of clinical information for a patient, who they see for the first time. The physiotherapist would then examine the patient and assess their findings to come up with a hypothesis for which they would provide treatment in conjunction with the patient or refine further with more tests. As the students were provided with relevant details of the patient's presentation in the case, they did not have to form hypotheses to the same extent as with a real patient, so this would account for less examples of this type of reasoning in the wiki texts. Nevertheless, students were presenting the related impairments and contributing factors to the patient's presentation, mostly in the wiki grids to explain their clinical reasoning. This can be seen in the following quotes which represent examples of diagnostic reasoning:-

'The cool down is necessary as cardiac patients are more of risk of hypotension (due to side effects of their medication).

Raised sympathetic activity during vigorous exercise increases the risk of arrhythmias during immediate period after exercise is stopped, therefore the cool down with help prevent this'. grid, WG2

'Reduced lung volume is a postoperative pulmonary complication attributed to poor positioning, anaesthesia and immobilisation.' grid, WG2

'ACBT facilitates mobilisation & expectoration of secretions in L lung when combined with modified drainage position as above' grid' WG1

Ethical reasoning only had one instance within the wiki texts:-

'There are some interesting points under non-compliance, the effect of age and daily life (fitting into society). One of the points made and should be remembered in the treatment of any CF patient is that incomplete adherence is normal and not to take a judgemental approach when discussing these matters with the patient.' Saskia, WG1,

This may have been because students were more focussed on giving an appropriate treatment rather than considering how they would apply the treatment. This indicates that more emphasis could be placed upon ethical reasoning in the learning experience.

This analysis of types of clinical reasoning within the wikis illustrate that students are doing clinical reasoning in the wikis in relation to the patient cases. They are also doing different kinds of reasoning in the wikis. The wikis are therefore providing an opportunity for students to practise clinical reasoning before they go on placement, a practice advocated by Eraut (2000).

5.4. Thematic analysis of the comments in the wiki texts

Finally a thematic analysis was carried out on the comments in the wiki texts according to Braun and Clarke (2006). The first analysis of the wiki texts was used to generate meaning from the data (Braun and Clarke, 2013). The twenty three codes generated in this way were then arranged into four themes. Although there are several ways in which the codes could have been arranged into themes, the derivation of themes was guided theoretically by aligning the themes to Vygotsky's sociocultural theory and concepts (Vygotsky, 1978), for later synthesis with the focus group and interview data. The codes and themes generated from the data generated are illustrated in Table 5.5. These results will be presented using the themes as subheadings.

Meaningful interaction	Scaffolding	Wiki as tool for learning	Internalisation (parameters based on expert reasoning)
Discussing treatment	Seeking tutor feedback	Wiki promotes information organising	Clinical reasoning uncertainty
Discussing research -	Seeking peer feedback - collaboration	Wiki promotes information sharing	Separating from group
Finding and using information	Peers giving feedback - collaboration	Wiki promotes pattern recognition	Hypothesising in uncertainty
Valuing knowledge / learning	Using tutor feedback	Wiki promotes talking about clinical reasoning	Put yourself in patient's shoes (caring for patient)
Doing clinical reasoning	Praising peers - collaboration	Wiki stimulates face to face talk	
Relating theory to practice	Challenging peers - collaboration	Wiki technology	
Stating actions			

Table 5.5 to show codes and themes generated from wiki text analysis aligned in relation to concepts related to Vygotsky's sociocultural theory (1978).

5.4.1. Meaningful interaction

Meaningful interaction must stimulate a learner and engage them in meaningful activity within a VLE to lead to substantive learning (Woo and Reeves, 2007). Our students who were used to learning underpinned by a behaviourist approach, may not have realised the value of the learning taking place within the wiki environment, even though the learning task the students were undertaking was authentic (Bower et al, 2006). The analyses of the wiki texts for evidence of critical thinking constructs and types of clinical reasoning showed that the learning tasks were achieving important outcomes. The interaction underpinning this is shown in the coding relating theory to practice and discussing treatment, illustrated in the following quotes:-

'Will we be able to use the stuff we did today (lung function) on Sean? Possibly as an assessment, to make sure his lungs are providing enough oxygen throughout time, or would this be for our COPD case study only?' F, WG1

'I agree, what could be really helpful is if we pick a few core exercises but then identify progressions and regressions i.e. step-ups, easy on the spot or hard up a step. Might also be worth mentioning the specific BORG scale we need to use (11 - 13) i think and also maximal HR.' J, WG2

Jensen et al (2000) highlighted how expert clinicians use the patient as a source of knowledge in their practice. For students in the theoretical part of their course, patient cases and the learning environment in which they are used should encourage the student to link their academic knowledge about pathology, anatomy, physiology etc to the patient presentation so that the students practise using new knowledge to relate theory to practice.

The students were discussing research in relation to the cases in a critical manner:-

'This one is a fairly easy read, it uses participants that have had abdominal surgery, including laparotomy and bowel removal. The intervention used is the same as our treatment plan and concludes that physio post opp improved oxygen-hemoglobin saturation. The down side is that it's carried out on immediate postoperative patients, during anesthesia recovery at the post-anesthesia care unit (PACU). The study indicates that as the improved values did not last two days, that benefit could be had from additional chest exercises during and after their PACU stay.' Saskia, WG1

They were sharing existing literature with each other as they discussed the research. Although students expressed some problems with finding information in the first few cases of the module:-

'...but if anyone can find a article for evidence for SOB, that would be helpful - im trying to get a relevant one and not really getting anywhere. thanks!' F, WG1

They approached this task with increasing confidence as the module progressed:-

'I've found evidence for using deep breathing exercises in order to improve lung function & prevent pulmonary complications after coronary heart bypass grafting. Thought this could be incorporated into the education section or as another treatment in his cardiac rehab.' L, WG2

The sharing of information included saving and sharing the information the students had used in the early stages of developing problems and treatments for the patient cases whilst they considered alternatives:-

'As we don't need all the information regarding assessment shall I put the excess info into a word document and email it to everyone as extras to talk about again like ...did?' A, WG1

This would suggest that the students placed value on what they had created and learnt.

Not only were the students interacting with each other in a meaningful way, but the interaction appeared to be carried out in a collaborative manner from the way in which comments were

written. However, students often started their comments with statements telling the rest of the group what they had done or were doing:-

'I've added positioning, though will combine it with the relevant ACTs when I do the editing end of next week.' B, WG1

'I've added some information to the assessment section, things that will help give a little more insight into Sean's current condition.' Susan, WG2

It would seem that meaningful interaction leading to some substantive learning was taking place in the wiki. How this related to developing clinical reasoning capability will be discussed further under the theme 'internalisation' because the interaction was taking place in an environment of seeming uncertainty about the concept of clinical reasoning. This raises the question about whether the interaction relating to clinical reasoning can be classed as meaningful, if the students were not clear about what they were learning.

5.4.2. Scaffolding

Scaffolding learning is an important concept in relation to Vygotsky's learning theory (Vygotsky, 1978) and can be considered a major affordance of the wiki in influencing clinical reasoning development by allowing conversation (Smith, 1999) and the participation of the student in the community (Wenger, 1998). Scaffolding of the students' learning took place in different ways in the wikis. The students were given feedback on their work in the wikis by a tutor from the module team and used this to scaffold their learning:-

'I've updated some of the clinical reasoning and treatment for the first treatment in line with what tutor mentioned.' J, WG2

At times they also sought tutor feedback both for clarification and reassurance:-

'Tutor I have put a different paper up for the passive movement. This is still a survey as they sent questionnaires to physios regarding if they carried out passive movements on sedated ventilated patients. Is this paper ok?' D, WG1.

The group sought feedback from their peers with areas in which they needed clarification:-

'also do u think the clinical reasoning for the each part of the physio treatment for the decreased CV fitness should be more specific or would that be putting too much info on the wiki.. for example.. clinical reasoning for warm up etc etc...' E, WG1

They gave feedback to each other where students needed help with their learning:-

'Its quite decent, although its an observational study which may not be ideal. Havent found a better (more recent one yet) found one from 1946 (old, i know)...' Susan, WG2

Minocha and Thomas (2007) found that students were reluctant to challenge or disagree with peers in their evaluation of a wiki which was used in a software engineering course. In this research, there were examples of group members challenging others in the wiki texts:-

'...I may have this wrong but I looked up laporotomy and it says abdominal surgery so maybe this paper isnt right for this patient. Not entirely sure thou!' D, WG1

Any challenges were made in a professional manner. However group members seemed much more willing to praise each other for the work that they were doing:-

'X, I have referenced your link - and pasted it here just case anyone needs it - it seems really helpful but if we can not use it, X's article seems very helpful!' F, WG1

The discussion taking place in the wiki texts and the way in which the discussion was carried out indicated that the groups appeared to be functioning collaboratively. Choy and Ng, (2007) have highlighted how important it is for a wiki group to function collaboratively to produce a successful outcome.

The early analysis of the wiki texts showed that all students participated in the wikis, although some students only made one or two contributions to the wiki texts. Others played a major role in scaffolding the students' learning as illustrated by the analysis which considered the number of times students had contributed to the wiki and the quality of their comments. For students who may not have felt very confident about contributing to the wikis, their learning may have been scaffolded in other ways. For example, the wiki groups also met face to face to discuss the wiki cases (as illustrated in the next theme) and all the students had the opportunity to view the wikis without participating. The access history of both wikis showed more views than contributions. In these wiki texts there is a clear indication that scaffolding of learning was occurring.

5.4.3. Wiki as a tool for learning

This theme provides a context to examine how the wiki as a pedagogical tool could provide a suitable environment in other ways to help learn clinical reasoning. The coding links the affordances of the wiki as it was used in this learning experience to its potential value in learning clinical reasoning. Groen and Patel, (1985) identified the link between pattern recognition and clinical reasoning amongst more experienced medical practitioners. Payton (1985) concluded that the reasoning strategies of more experienced physiotherapists were similar to that of more experienced doctors. It therefore seems reasonable to suggest that a pedagogical tool that is intended to help students learn clinical reasoning should promote pattern recognition and

information organisation. The wiki texts contained examples of both these affordances, the promotion of information organisation and pattern recognition:-

'i have moved the exercise section in to the self management like discussed as it wouldn't be used as an individual treatment.' K, WG2

'I've copied the assessment info from our other grids'. A, WG1

Ajjawi and Higgs (2008) emphasised the importance of communicating about clinical reasoning to others to help develop the skills of clinical reasoning. As already highlighted in the clinical reasoning analyses, the wiki demonstrated the affordance of communication by promoting information sharing about clinical reasoning and information to support reasoning about the patient cases. The wikis promoted face to face talk about clinical reasoning through the learning experience of working in a wiki group:-

'i have found an article for ACBT and COPD but unsure how relevant it is so haven't put it on the wiki i will bring it in to lesson so we can decide between us!' K, WG2

For the students to benefit from the affordances of the technology, the wiki technology needs to work and be easy to use. The analysis of the wiki texts only highlighted three examples of problems with the wiki technology. This indicated in this analysis that the students did not appear to be having significant problems with the technology.

The theme of 'wiki as a tool for learning' relates to Vygotsky's concept (1986) of semiotic mediation. The wiki acted as the mediator of knowledge construction about clinical reasoning by scaffolding learning and affording ways of patterning and organising information. The analysis of the wiki texts demonstrates that students were carrying out meaningful interaction by using critical thinking skills and doing clinical reasoning in the wikis. Not only were the students communicating online in the wiki about clinical reasoning, the wiki learning task also stimulated face to face discussion. From these findings, the wiki learning experience seemed to be making a significant contribution to the development of clinical reasoning skills for these students.

5.4.4. Internalisation

The fourth theme identified in relation to the wiki texts is tentative and relates to Vygotsky's concept of internalisation. Further analysis of and synthesis with the interview data will confirm and strengthen this theme. John-Steiner and Mahn (1996) described how *'...Vygotsky conceptualised development as the transformation of socially shared activities into internalised processes.'* (p3) The development of clinical reasoning in the wiki started as socially shared interaction about clinical reasoning and transformed into individual higher mental functioning

about clinical reasoning. The code 'clinical reasoning uncertainty' may illustrate the first step in the process of the internalisation of clinical reasoning. Although students were doing clinical reasoning of different types in the wikis as evidenced by the initial clinical reasoning analysis of the wiki texts, the code of 'clinical reasoning uncertainty' emerged because the students seemed unsure about what constituted clinical reasoning:-

'wasn't too sure how much detail to go into for clinical reasoning'. A, WG1

'Will find some more information on clinical reasoning, in the meantime feel free to add relevant information' Susan, WG2

'Also has mentioned about moving some clinical reasoning to the evidence section. I will give this ago and then everyone can say if it looks right or not and i'll change it again', D, WG1

Students also seemed to encourage others to complete the clinical reasoning information in the grid:-

'I think the first box with the ACBT and manual techniques need to be more detailed in clinical reasoning so if people want to add more info that would be good', D, WG1

'Anyone is more than welcome to add in the clinical reasoning ...', F, WG1

Another common kind of statement related to filling in things in the grid which could be sourced from existing literature but stating the intention to complete the clinical reasoning at a later time:-

'I have added the second problem..more clinical reasoning is needed for sure, I will try to add some more over the weekend.' Sheila, WG2

Comments indicating procrastination or asking for others to complete the clinical reasoning sections in the wiki indicate a lack of clarity with the concept of clinical reasoning and show what a pre-registration physiotherapy student from a traditional course may understand about clinical reasoning at this stage in the course, prior to clinical placements. The concept of clinical reasoning for these students was embedded in their learning in the theoretical part of the course. Although this is common practice in physiotherapy pre-registration courses, it can lead to the feeling described by Christensen et al (2008) that learning about clinical reasoning has been devolved to the students themselves. This means that students may not recognise the importance of the skill for professional practice (Christensen, 2007).

Other codes relating to internalisation were only supported by a few comments, several of these were from the same student. As the students developed their knowledge and understanding in

relation to the module, some students decided that it may be in their interest to separate from the group and produce their own patient treatment grid for the assessment:-

'This may be where we all decided individually to tweak the grid to suit our own views for specific treatment in the exam.' C, WG1

This kind of comment may indicate that these students are starting to develop a clearer understanding of the concept of clinical reasoning.

The final set of codes all came from the same student who demonstrated the skills of hypothesising in uncertainty and putting yourself in patients' shoes:-

'I made a huge assumption about the osteoporosis part, I think because we have so little info about the patient I just assumed that his condition and age would suggest a high chance he was on corticosteroids to manage his condition' Saskia, WG1

'I can only imagine how scary it must be to experience SOB so training and advice to manage the symptoms by herself would be useful.' Saskia, WG1

Both these concepts have been linked to the parameters identified by Jensen et al (2000) which relate to expert clinical reasoning.

5.5. Thematic analysis of the focus group and interview data

The thematic analysis of the focus group and interview data was carried out in a similar manner to the thematic analysis of the wiki texts, according to Braun and Clarke (2006), initially to generate meaning from the data (Braun and Clarke, 2013). The codes generated in this way were then arranged into themes, guided theoretically by aligning the themes to Vygotsky's sociocultural theory and concepts (Vygotsky, 1978), for later synthesis with the wiki text data. The data from the initial focus groups and interviews was analysed after collection so that themes identified in this dataset could be considered in the follow up interviews. When the data from the follow up interviews was analysed, in a similar manner to that used for the initial focus groups and interviews, it was found that several of the initial themes identified were confirmed in the subsequent analysis. From the data analysis, it also emerged that there were two distinct aspects to the data, clinical reasoning development and how the wiki had mediated this process.

Five main themes emerged from the initial focus group and interview data, three of these relating to clinical reasoning development; process of understanding the concept of clinical reasoning, defining clinical reasoning and ways of developing clinical reasoning. The two other themes were the wiki as a tool for learning and the wiki learning experience, both related to how the wiki mediated the students' learning. Seven main themes emerged from the second interview data,

three of these relating to clinical reasoning development; process of understanding the concept of clinical reasoning, defining clinical reasoning and ways of developing clinical reasoning. The four other themes related to the students' learning experiences on the course and how the wiki mediated these. These were the wiki as a tool for learning, the wiki learning experience, the taught course learning experience and the placement learning experience. The findings from both sets of data will therefore be considered together in this section, showing where findings of the two datasets were similar and highlighting where they were different. Managing the data in this way started to synthesise the findings which allowed the research questions for this thesis to be answered. The results section has therefore been divided into these sections.

5.5.1. Clinical reasoning development

Vygotsky (1978) explained that to understand development, it is necessary to study it historically. Studying the process of development of clinical reasoning capability at different time points from the students' points of view also gave insight into research sub-questions one and two:-

1. What does the pre-registration student understand by clinical reasoning?
2. What is the process of development of clinical reasoning from the pre-registration physiotherapy students' perspective?

Table 5.6 shows themes and codes generated from the initial dataset after students had completed at least one (n = 5) and up to two (n =3) clinical placements. The initial focus groups and interviews considered the taught part of the course, the wiki and the experience of these initial placements in the development of the students' clinical reasoning.

The second set of interviews took place after students had completed between three and all six of their clinical placements so represent different stages in clinical reasoning development amongst the students. At this stage, all of the students had developed a clearer understanding of clinical reasoning and some had internalised the process. The codes and themes relating to this data are illustrated in table 5.7. The results will be presented using the themes as sub-headings.

Defining clinical reasoning	Evidence to support treatment Based on knowledge Based on assessment Patient centred Based on patient experience Influenced by the therapist Influenced by the environment
Process of understanding the concept of clinical reasoning	Confusion about clinical reasoning Awareness of clinical reasoning Practise contextualises reasoning
Ways of developing clinical reasoning	Justifying treatment to others (<i>to self, to patient, to supervisor</i>) Communicating with others (with supervisor, other physiotherapists and members of MDT) Writing notes Taking responsibility for patients Repeated practice of clinical reasoning <i>in wiki, acute care placement</i> Clinical experience Reflection on practice

Table 5.6 to show themes and codes related to clinical reasoning development from analysis of transcripts of first focus groups and interviews.

Defining Clinical Reasoning	Justifying practice
Process of understanding the concept of clinical reasoning	Confusion about reasoning Awareness of clinical reasoning Clinical reasoning is 'simple'
Ways of developing clinical reasoning	Working with patient Working in a multidisciplinary team (MDT) Using other tools New clinical areas Critical incidents Thinking about reasoning Support from educator Clinical experience Writing reports and notes

Table 5.7 to show codes and themes related to developing clinical reasoning from analysis of second interviews

5.5.1.1. Defining clinical reasoning

This theme relates to how students understand clinical reasoning at a particular stage in the course and so links to research sub question one. The wiki texts suggested that there was

confusion about the concept of clinical reasoning and this was confirmed in the focus group and interview data. Data from the initial focus groups and interviews showed that students may be able to define what clinical reasoning is but not completely understand what the concept means. At this stage in the research, students explained what they thought clinical reasoning was. Rather than being able to give a complete definition of clinical reasoning, their comments gave partial explanations of what clinical reasoning is, as their understanding of clinical reasoning continued to develop. The students explained that clinical reasoning was about justifying their treatment with evidence:-

'Clinical reasoning to me, is having evidence to support the treatment for whatever we're using to treat the patient so it just backs up why you're doing it and what you're doing and why you're doing it, ' Sharon, interview one

In the university the students had been asked to justify the treatments they chose to use in the wiki with research evidence and so had thought they may do this in practice as well to support their clinical reasoning:-

'I haven't had to go you know, in my work placement, in my placement I haven't had to um, everything I had done I didn't have to go on the computer and then find the research behind it, it was, er, just me justifying that I was doing then my educator was saying well, yeah, you're justifying what you're doing ... Sonia, interview one

However, they understood the importance of having evidence to support practice in clinical reasoning:-

'I think it's also important as well to have the evidence behind what you're doing to be able to give the patient options as well these days' Saskia, focus group B

The students understood that clinical reasoning should be based on their knowledge and their assessment findings:-

'Oh, I suppose in terms of healing times, so sort of looking at um, what we knew about the physiology of things then looking at healing times and understanding what you did during those healing times so that, yes, I suppose that is clinical reasoning isn't it?' Sharon, interview one

'But for me clinical reasoning basically getting details from the patient and adapting my treatments or assessments based on the information they gave me, basically.' Sheila, focus group A

The students recognised that clinical reasoning should be patient centred:-

'For instance I had, my old assessment of a patient, and he couldn't get out of the chair at that point in time. And I asked how do you, are you able to stand-up from a chair and he said yes, but

my chair at home has a remote control and I can push it up. So then I said well it's pointless me trying to help you get out of this chair, let's sit on your bed and I raised the bed up to the height that your chair goes, and we'll see if you 're able can get out now. And then when I got the bed up to that height he could stand. So he was basically explaining, he'd been saying he was safe to go home because when he goes home that'll be the situation he's going to be in So that was what clinical reasoning was for me basically,...' Sheila, focus group A

'Trying to make it sort of patient centred so thinking of the holistic view rather than just, oh, this is a limb I've got to be treated. How does it fit in to their lifestyle functionally?' Susan, focus group A

This included using the patient's experience of treatment in their reasoning:-

'Um, based on their (the patient) experiences, if they'd had treatments before, then yes, if they'd said if they've been in and they'd said oh I've had this before and this is what we did then that's going in the patient experience and I suppose if it worked before then it's going to work again' Sharon, interview one

The findings relating to clinical reasoning being patient centred are in contrast to other research about physiotherapy students and clinical reasoning (Hendrick et al 2009; Cruz et al, 2012). Both these studies showed that clinical reasoning was not conceptualised as a patient focussed activity by physiotherapy students even towards the end of their course. Using patient cases in a wiki may help students to see the patient as the focus of their clinical reasoning.

Students also understood that their reasoning could be influenced by the environment in which they were working and the methods that a therapist may prefer to use could influence treatment and clinical reasoning:-

'...yeah being aware of the options that are available to then offer that to the patients so, um, but then within the workplace you've also got the workplace sort of, er, um ways of working.' Sonia, interview one

The students were able to define clinical reasoning by describing different parts of the whole at this stage in their course. This indicates that there was still a lack of clarity with the concept of clinical reasoning, which had first been suggested in the wiki texts. Data from the follow up interviews suggested that students were better able to define clinical reasoning. Higgs and Jones (2008) defined clinical reasoning as:-

'the sum of the thinking and decision-making processes associated with clinical practice.' (p4).

For students to have appropriated clinical reasoning, how they define clinical reasoning should reflect this definition and the complexity of clinical reasoning in relation to the professional attributes of autonomy, responsibility and accountability and making decisions in conditions of

uncertainty. Students defined clinical reasoning in slightly different ways but recognised it as a way of justifying their practice:-

'...like it's a simple concept, clinical reasoning now is like, it's just your thought process, I don't know if I'm right mind, it's just your thought process and writing it down or just showing why you did it or somebody else can read it and see in your notes, why did you do it...,' Sheila, interview two

Sheila had completed three clinical placements when she made this statement. Although she recognises that clinical reasoning is about justifying practice to others, her definition does not encompass the complexity of the construct in the same way that Sally's definition does:-

'I would probably say it's kind of providing the, um, what's the word? Providing a rationale for you acting and kind of treating and managing in the way that you do. Um, so kind of yeah providing a rationale that supports why you've done what you've done. Um, kind of and I think you kind of have to include kind of the pros and cons of it as well, kind of, um, both sides of the picture I think, um, in terms of well, I could've done this but I couldn't because of this kind of so it's a bit of a discussion as well in a way.' Sally, interview two

Sally had completed all six of her clinical placements at the time of the second interview and her understanding of the concept of clinical reasoning would appear deeper and more complete as she shows autonomy, responsibility and accountability in her definition as well as showing how she is coping with an element of uncertainty ('...I could've done this but I couldn't because of this...') in her decision making. This would indicate that she has internalised the concept of clinical reasoning. Her knowledge underpinning clinical reasoning will be socially constructed, internalised by the individual and transformed into new understanding and consciousness (Liu and Matthews, 2005).

In this analysis students also showed that they understood that clinical reasoning could not only justify their practice but provide justification for the physiotherapy profession as a whole:-

'...clinical reasoning is something to prove your practice, prove you know, we'll always want sort of to prove why physiotherapists are needed, so by clinically reasoning we're showing that yes, this is why our role is important here...' Sarah, interview two

'I think its, um, in the NHS you've got to justify everything you're doing, so you've got all your outcome measures to use and you've got to be specific with what you're doing because you've got to show that you are being effective in the job.' Sharon, interview two

This shows that the students were also starting to understand how clinical reasoning is at the heart of professional practice.

5.5.1.2. Process of understanding the concept of clinical reasoning

In the initial focus group and interview data, the students described some confusion and lack of clarity in relation to clinical reasoning during the taught part of the physiotherapy course:-

'I think even when we had the wikis, that (clinical reasoning) was almost the most difficult part to follow. I think it was, then you was just trying to do it by rote, it wasn't coming to you automatically.' Sheila, focus group A

This lack of clarity had stayed with the students into their first placements, reflected in their thoughts that they would have to justify their clinical treatments with evidence:-

'They (placement educator) said I was really good at clinical reasoning, because I'd question things when I came out of the booth so I'd say oh, why would you do that, they said you're doing it because you're questioning what you're doing, um, I didn't feel like, I suppose that wasn't my understanding of clinical reasoning, I probably put it down to evidenced based practice, looking at evidence and backing it up.' Sharon, interview one

Sharon went on to express some confusion about the concepts of evidence based practice and clinical reasoning. It was not clear from the taught part of the course that evidence based practice is part of clinical reasoning:-

'I think my confusion in a way comes from what clinical reasoning is and what evidence based practice is, I seem to have, I think maybe what we do on the wikis is evidence based practice and that the clinical reasoning is, maybe the wording of the clinical reasoning is something different, I don't know how to word it, but it's...' Sharon, interview one

The lack of clarity in regards to clinical reasoning is summed up in the following statement from the first dataset, which describes how clinical reasoning was talked about in the course but never really explained fully:-

'... it has been explained from the beginning um, in our teaching, um, how you demonstrate your clinical reasoning has been sort of a little bit more fuzzy um,...' Sonia, interview one

The second interviews reconfirmed this confusion about the concept of clinical reasoning as the students started their clinical placements.

'If I was to be completely honest I think back then (starting clinical placement) I was really confused as to what clinical reasoning was Like I understood it but every time I tried to understand it I lost it again, do you know what I mean?' Susan, interview two

They confirmed how they had thought clinical reasoning was something very complicated because of their experience in the wiki and how they thought they needed to use research evidence to support all clinical reasoning thus confusing clinical reasoning with evidence based practice:-

'Well, if it's something as simple as if somebody's short of breath and you're doing your CPT and they're doing it and they go to do a respiratory hold and you say OK you don't have to do that because it's going to increase their shortness of breath and I'm going to do their CPT without any respiratory hold and I write that in their notes because, that is clinical reasoning. Yeah well when you're at uni say you went and do it but didn't realise because you thought clinical reasoning was so complex that you had to go and see in a journal in order to arrive at an answer for it, to be clinical reasoning it had to be in a journal, it had to be something you look for on the way, it's got to be something you just reason.' Sheila, interview two

The link between theory and practice, the critical and reflective skills needed for clinical reasoning and the importance of clinical reasoning was therefore not clearly made to the students because clinical reasoning was embedded in the course. These statements give support to the suggestion that students were struggling with what to put in the clinical reasoning section of the wiki grid in the comments from the wiki texts, because they often said they would do this part of the grid later or asked others to fill it in. These findings confirm those of Christensen et al (2008), who suggested that in traditional courses, physiotherapy students are often left to learn clinical reasoning by themselves. The confusion that the students have in relation to clinical reasoning and evidence based practice is an important finding and needs to be addressed with future cohorts of students. Using evidence in the way that we ask the students to in the wiki, increases the layers of complexity in learning from the patient cases and so helps to develop skills which are used in clinical reasoning (Pesut, 2004).

Although the concept of clinical reasoning was not clear, the students' awareness of clinical reasoning in the course was heightened by the wikis because they had the clinical reasoning column to fill in, in the wiki grids:-

'I'd say when we started work on our first wiki, that was when we first came across it because it was under one of the headings so we had to go back and think well what do they want us to put in that section.' Susan, focus group A

Data from the follow up interviews confirmed that the wiki had highlighted clinical reasoning in the course:-

'No, I do remember in the box clinical reasoning for, um, the wiki group and I'm thinking back to that. That was probably the first time I'd thought about clinical reasoning.' Sharon, interview two

For these students, actually having to think about clinical reasoning in the wiki meant that the 'embeddedness' of clinical reasoning within the course was reduced. The students were being prompted to do clinical reasoning even though the concept of clinical reasoning seems to have been largely left to the students to understand themselves. This finding also needs to be

addressed with future cohorts of students. This emphasis on thinking about clinical reasoning as a concept in the wikis had a slightly unfortunate consequence because the students did not link clinical reasoning to other areas of practice in the course:-

'I would definitely consider on our course that clinical reasoning was more of a feature in Respiratory than any of the others, even if like you say it was discussed and it was mentioned and stuff, but not quite as much.' Sally, focus group B

By embedding clinical reasoning into the curriculum in the course, the importance of clinical reasoning as the basis of future practice seemed to be lost:-

'I didn't realise how important it (clinical reasoning) was until I got out on placement. It was a term I think, kept coming up maybe in the first year and then it wasn't until we started looking at more in the second year and then actually now going out on placement you understand, especially as part of your, your er, marking scheme is a big chunk of clinical reasoning...' Sandra focus group, A

Sandra's statement about the large amount of marks (40%) which are given to clinical reasoning when the students are on placement are also reflected in her surprise about being assessed on this:-

'I didn't even look at that, I hadn't even seen that form until like half way in my first placement and then discover, oh this is what I'm being assessed on, oh OK kind of it was all came like as a bit of a shock didn't it.' Sandra, focus group B

All of the students agreed that clinical practice contextualised clinical reasoning and made the concept of clinical reasoning easier to understand. This is hardly surprising for these students because they had never had the concept of clinical reasoning clearly explained to them:-

'... um, actually when you're out in the real world it can be just something really, really small like you say for your objective and subjective, well I pulled that and I pulled that and that's my reason for why I'm doing, even just getting someone up, standing them up and walking them, why, why am I doing this?' Saskia, focus group B

It is clear that there is confusion about the concept of clinical reasoning as students finish the taught part of the course. Although the wiki emphasises clinical reasoning and seems to be the point in the course at which students start to demonstrate and practice clinical reasoning, the students do not necessarily realise that they are doing clinical reasoning. Emphasis on literature to evidence practice may influence how the students understand the concept of clinical reasoning. Emphasising clinical reasoning in one part of a course in which clinical reasoning is embedded, may mean that students do not recognise the importance of clinical reasoning as the basis of professional practice.

Students referred to clinical reasoning as being '*simple now*' in the second interviews. This means that they had a clearer idea of what clinical reasoning is and felt comfortable doing clinical reasoning:-

'Yeah, it is (simple). And it's just not, I don't know, I just think it's, clinical reasoning is in every single aspect of the work that we do, um, yes it's just a bit sort of second nature like...' Saskia, interview two

'... therefore it is becoming far more automatic 'cos your perspective on it was different, if that makes sense. I feel like my perspective is more, I'm kind of, I guess I'm sold on clinical reasoning, you could say it like that in a way, that it's not kind of something I feel obliged to do but it's something that I believe in.' Sally, interview two

Both these students talk about clinical reasoning as being automatic or second nature now showing that they recognise clinical reasoning and are able to talk about how they think about it. This clearly shows that they have internalised clinical reasoning. Being able to explain and define clinical reasoning links with Vygotsky's theory of internalisation as described by John- Steiner and Mahn (1996), '*the transformation of socially shared activities into internalised processes*', (p3). This could take the form of discussion between a clinical educator and student or participation in a case based wiki, into internalised processes which allow higher mental functioning and the ability to reason clinically as a competent novice practitioner.

5.5.1.3. Ways of developing clinical reasoning

Just as all the students found that practice contextualises reasoning, there were clear ideas about how their clinical reasoning developed in clinical practice. The students were able to describe different ways in which the development of clinical reasoning could be facilitated. The first of these was by justifying treatment or explaining why they were doing something to the patient:-

'And so the second time I saw her I was sort of anticipating that she was going to ask me something. So every time I did a treatment, um, before she would ask me, I would say I'm doing this treatment because of this and it has these effects, um, and then she'd ask me questions and I could relate back to why I was doing it because I had some sort of clinical reasoning in place so it made it easier for her to understand that I wasn't just moving a limb around.' Susan, focus group, A

Students also had to justify treatments to their clinical supervisor who was ultimately responsible for the treatments that the students carried out:-

'I suppose the clinical educators as well, they're expecting you and it's a one on one and they're looking at you, OK you've said this is the treatment you're gonna use, what's your clinical reasoning?' Saskia, focus group B

Saskia went on to explain that it was important to understand why she had made clinical decisions and clinical reasoning was a way of doing this:-

'... it's like we were saying, it's like evidence based practice, so you do something, you do a treatment but you need to justify your decision process, it's a way of justifying it to other people and to yourself really, an understanding of why you've chosen to do something.' Saskia, focus group B

Being able to justify what you are doing as a professional is a foundation of professional practice. Justifying treatment was part of the wiki learning task and it was evident in the wiki texts that students were starting to develop this skill. Justifying treatment involves communicating about clinical reasoning to others and this has been shown to develop clinical reasoning (Ajjawi and Higgs, 2008). For students this could be explaining their clinical reasoning to their supervisor or talking about their clinical reasoning to other members of the physiotherapy or wider multidisciplinary teams:-

'... when you went on placement you find that everybody works in a team and then you often, even the seniors are like, not students and juniors, so they talk to one another and come up with different solutions and they encourage you to talk to them, if there's a problem then that comes up. If you see a patient and just say casually discuss it with someone on your team and justify what you was doing was correct...' Sheila, focus group A

Writing patient notes was identified as a way of developing clinical reasoning especially as students started to realise the level of detail that is required in patient notes to justify their treatment:-

'... to show what she (the supervisor) really wanted me to do was make my assessments very specific, showing in my notes that I was reasoning through and why I was discharging a certain patient. At the beginning of the placement I'd say OK that's fine and I'd write in the notes that they get to the shop independently but by the end of the placement I'd be saying how do you get there, do you walk, do you fly, do you catch a bus?' Sheila, focus group A

Taking responsibility for a patient and considering the effect that their clinical decision making could have on a patient's life was recognised by the students as an important process in developing their clinical reasoning. This is illustrated in the following quote:-

'I was going to say, I think when you've got responsibility on deciding a patient's treatment I think at that moment that you know it's your responsibility to decide the best treatment for that patient at the time, and you then kind of feel instinctively that you need to back yourself up with that

choice so when you have to make the choice, I think for me was definitely the point at which I felt I needed to base that choice on something.' Sally, focus group B

The burden of taking responsibility for a patient was illustrated further by Sally who explained how taking responsibility for a patient was different to working with patient cases in the wiki, even though their results in relation to the wiki module could have an effect on their progress through the physiotherapy course:-

'You're kind of in the dynamic of, you're trying to pass an exam, you're trying to achieve that one thing as opposed to the reality of being a really important person in someone's life and you having responsibility for something in their life, it's got a lot, it's kind of, not that any one thing is necessarily more important than another or anything but it's just a different dynamic I think, isn't it, a different, your kind of emotional involvement in it is entirely different. The exam at the end of the day you didn't do well in the exam that's you and that only affects you in a way, whereas the responsibility with a patient changes your attitude towards it no matter how much you kind of care about your result in the exam or whatever, it's still only you that's affected by your decisions'
Sally, focus group B

The students' duty of care for their patients, explained as taking responsibility for the patient, was a powerful tool for developing their clinical reasoning. Jensen et al, (2000) has described how the virtue of caring is another feature of expert physiotherapist practice and strongly influences clinical reasoning and decision making. As the students gained more clinical experience, they began to realise that they were working with the patient in their treatment. Rather than feeling completely responsible for the patient's recovery, the students had now started to recognise that their clinical reasoning should be carried out collaboratively with their patients to try and optimise the outcomes from their treatment:-

'And then when people give you realistic goals or unrealistic goals then it's a negotiation and understanding then of do you think that is going to be achievable in 6 weeks time or.... Sharon, interview two

This kind of collaborative reasoning would indicate an important step towards the appropriation of clinical reasoning. Collaborative reasoning with the patient was impossible for the students to practise in the wiki cases, so it was important that they developed this kind of collaborative practice in their clinical placements. Collaborative practice with the patient at the centre has been described as something carried out by expert physiotherapists (Jensen et al, 2000). Sandra summarises this important difference between the wikis and clinical practice and developing collaborative reasoning in the following statement:-

'I think you also kind of you have a talk with the patients you're going to find out more what their goals are and what they want to achieve and you take that into account when you kind of do your

treatment and not just what you learnt and just be like kind of there um, kind of condition or something, just in mind take into account what your treatment will be, what your planning will be, as before when you just kind of have your texts with the patient, we don't really know him, what he wants to get out of it or where he wants to go back or all the factors in his lifestyle, what will be influencing it.' Sandra, interview two

Eraut (2004) highlighted how practising clinical reasoning with patient cases prior to practice may help with clinical reasoning in practice. The students recognised that the wiki had helped them practice their clinical reasoning before going into practice:-

'I think if we hadn't done what we did, what we've done as part of our course, if we hadn't done that prior to placement I think I would've found clinical reasoning a lot more difficult, so I think having had it all introduced and gone through it in a kind of theoretical way, before you then have to do it in reality, I didn't realise how much that was going to help me at the time but I think if I hadn't done all that kind of theoretical clinical reasoning in the wiki before I had to do it in practice I would've struggled a lot more with it, if that makes sense?' Sally, focus group B

'Um, yeah so the, obviously the wikis, were the biggest, er biggest part of clinical reasoning I think. As we said before, it was mentioned before but I don't really feel I put it into practice at all until we got into the wiki stage, which you know took some time to get used to.' Saskia, focus group B

Both these statements show the students reflecting on the wiki learning process and how this process of reflection, after their initial clinical placements, demonstrates the value of the wiki learning experience in helping to develop their clinical reasoning. Because the students did not fully understand the concept of clinical reasoning, the value of the wiki learning experience was only highlighted when the students were doing clinical reasoning on placement. On this course reflection as a way of learning was emphasised just prior to clinical placement and so the students may not have been reflecting on their learning prior to placement. However once the students started using reflection in the clinical arena, they did recognise the value of reflecting on their clinical and learning experiences to develop their clinical reasoning:-

'And 'cos I had someone who, um, passed out on me when I was walking them and that's what I mean by my reflection again, I was like oh my goodness, now I really need to make sure I understand why I did that, because I've got to back myself up, that was sort of backtracking and thinking, why did I make that decision?' Saskia, focus group B

'...and now reflecting back, you can actually see well, that the whole process (the wiki) has actually helped me develop skills in clinical reasoning, develop skills in researching not only for Cardio but in general...' Susan, focus group A

At this point in their course, the students had made significant steps in their clinical reasoning development. Their understanding of the concept of clinical reasoning had broadened and they were aware of ways in which they could enhance their clinical reasoning. Communicating and

justifying their reasoning to others is related to Vygotsky's concept of the 'zone of proximal development' (Vygotsky, 1978). Although students were reflecting on their learning about clinical reasoning, demonstrating that they were using metacognitive skills which could be considered to start to reflect internalisation, this was still taking place in a persisting 'fuzziness' about the concept of clinical reasoning, with the image of the concept coming into focus intermittently.

Several of the ways in which the students said that they had developed their clinical reasoning in the initial focus groups and interviews were confirmed again in the data from the second interviews. These included gaining clinical experience, support from and communication with their clinical educator and colleagues and writing down their reasoning in notes and reports. Different ways in which students developed their clinical reasoning were highlighted in the second interviews. Working within the MDT had been a way of helping to develop clinical reasoning for some students. Communicating with other members of the MDT was important. For example, Susan explained how important it was to obtain information about patients from the nurses. This could then be used in the students' clinical reasoning:-

'Whenever we go to see a patient that's the first person we liaise with, you know how the patient's doing and they can give you a full up to date history of what's going on that day, whether or not they're appropriate for physio and what they need to work with, so...' Susan, interview two

Their clinical reasoning also developed working within the MDT when the students had to explain to others why physiotherapy may or may not be appropriate for particular patients:-

'I think that's something we could take away as well like in a clinical setting, obviously everybody knows what, well not everybody but most people understand physios are there to come and mobilise or could do some chest work, but now looking back we can tell them yes, this is appropriate or no this is not appropriate, based on what we've learnt (about clinical reasoning)...' Susan, interview two

New clinical areas, which can be described as areas of practice about which the students had only a small amount of prior knowledge from the taught part of their course, made the students use their clinical reasoning skills carefully. In these kinds of practice areas such as learning disability, they recognised that they could not draw on previous experiences but had to create new meaning for themselves in relation to their reasoning. Sally describes this experience below:-

'...and then my final placement was, um, like a Learning Disability placement in community, which, um, again is really different to what I'd done before as well, um, and a very different style of work, um and because you don't have any I think because I didn't have any exact, you know, we don't necessarily cover Learning Disabilities on the course and stuff and you had to think a bit more out of the box and kind of engage your brain a bit more rather than answers kind of being

automatic to you, um, so I think that was again was a step up from before, um, so I wonder if each of my placements have kind of built on the importance of and the difficulty of clinical reasoning. I think the more difficult and challenging it is the better my skills have got if that makes sense?' Sally, interview two

From their clinical experiences, other students also recognised the value of other tools which their clinical educators had introduced to the students, to help with their clinical reasoning development. These consisted of forms of different kinds, such as assessment forms:-

'Um, they did give me some like, some assessment forms and kind of result, like it was kind of like an assessment form which would then result in your decision. Um, but actually, um, I found those quite difficult to work with because I found them a bit too structured so they didn't kind of let me think naturally so I almost took those forms and kind of, kind of created a theoretical form in my own head that I would, so it was kind of a similar sort of process but I kind of developed my own form in my own head.' Sally, interview two

Some clinical placement areas were also using clinical reasoning forms to help students develop their clinical reasoning:-

'I think my last placement probably brought it all together much more so, um, we had clinical reasoning sheets to follow which were problem orientated so once we identified the problem, to write the smart goals up and to write the reasoning behind that, so the three areas went together, there were 3 areas on the sheet.' Sharon, interview two

The similarity between the clinical reasoning form which the educators had given to the student and the structure of the wiki shows how the wiki may be a useful tool to develop clinical reasoning by reflecting practice because the clinical educator was using such a tool to help the students develop their reasoning. Tools of this type can help to scaffold and add structure to a student's thinking about clinical reasoning, just as the wiki had done earlier in the course.

The other new way of developing clinical reasoning which emerged from the second interviews was the occurrence of and reflection on critical incidents. A critical incident can be defined as:-

'...distinct occurrences or events which involve two or more people; they are neither inherently negative nor positive, they are merely distinct occurrences or events which require some attention, action or explanation; they are situations for which there is a need to attach meaning...' (Fitzgerald, 2000, p190).

Students described critical incidents with patients which had developed their reasoning skills for example by confirming that they had considered their clinical reasoning thoroughly as described in this unfortunate incident:-

'I was asked to go and see a patient by myself, um, I was told by my educator that it was OK for me to do that, um, that it would be to practice transfers and it'd be fine for me to do it with the assistance of one. And I'd seen the patient before and I didn't feel comfortable with that decision that he'd made and I think that's where it, before, again I wouldn't have had the experience or perhaps the confidence, I wouldn't have been able to clinically reason my justification for not wanting to see that patient, before I would've just said yeah, OK, if that's what you want me to do I'll do it 'cos I'm taking their word for it whereas now I have learnt how to make my decisions based on a variety of different things, I've gathered all my information, I'd seen the patient before and I'd only ever done, um, a transfer with two people. Then knowing what his present situation was, why he was in hospital, um, his condition, um, past medical history, it was all adding up to me not thinking that that was a sensible option. Um, and as it turned out it wasn't, the, my educator knew I wasn't comfortable with it and I was questioning his decision so he came with me, to show me how to do the transfer of the single person and actually the patient did fall over as I was predicting was probably going to happen.' Saskia, interview two

This incident demonstrates how Saskia had internalised the concept of clinical reasoning because she feels able and confident enough to challenge her supervisor by thoroughly thinking about her clinical reasoning in relation to the case. She is showing autonomy, responsibility and accountability, as well as coping with uncertainty in her clinical decision making and demonstrating the use of metacognition in relation to her reasoning. Other students also showed how they were thinking about their reasoning and using metacognitive skills in relation to their appropriation of clinical reasoning. In the statement below, Susan shows how her knowledge in relation to reasoning has improved and how she has evaluated and reflected upon the process of her clinical reasoning development:-

'And I think it sounds funny but it's almost not innate but in-built now but we're still thinking about it whereas but before we'd be thinking about it but you wouldn't have any structure in your head of why you're thinking about it but now we've got the both, um, it's interesting to see when you actually deal with patient, you know, there's a degree of, I think they call it procedural reasoning where it's right you've got this patient in front of you and they've got this problem, this is my treatment based on, you know, what I found but there's also a degree of, I don't know what they call it, interpersonal reasoning, or where you've got each patient who's individual as they are, um, and you have to work on, you know, getting the best out of them from what you've seen and how you've built a relationship with them, it's interesting to see that in a clinical setting that all fits together.' Susan, interview two

Thinking about learning clinical reasoning and the way in which students were doing this would also indicate internalisation of the concept as they demonstrated how this would be an ongoing process in relation to their professional practice:-

'I know I'm going to keep learning and learning as I go on, um, you know I know it's always a continuous development but I think initially it will be really be back to my basics and develop on that and you know again that is, that is your clinical reasoning as well.' Sarah, interview two

The analysis of the second interview data showed further development in the students' clinical reasoning capability, confirmed some ways of developing their reasoning and that the students were also using new ways to do this. Students showed that they were starting to internalise the concept by explaining how they thought about their reasoning and that for them clinical reasoning had become 'simple'. The development of the students' clinical reasoning capability is summarised in figure 5.1. The blue boxes have been highlighted as ways in which students in this research developed their clinical reasoning from the wiki and whilst on clinical placement and the influence of each will vary for different students. These ways in which the students' learning developed their clinical reasoning whilst on placement can be linked to how the wiki mediates the students' learning about clinical reasoning and this will be considered further in the discussion.

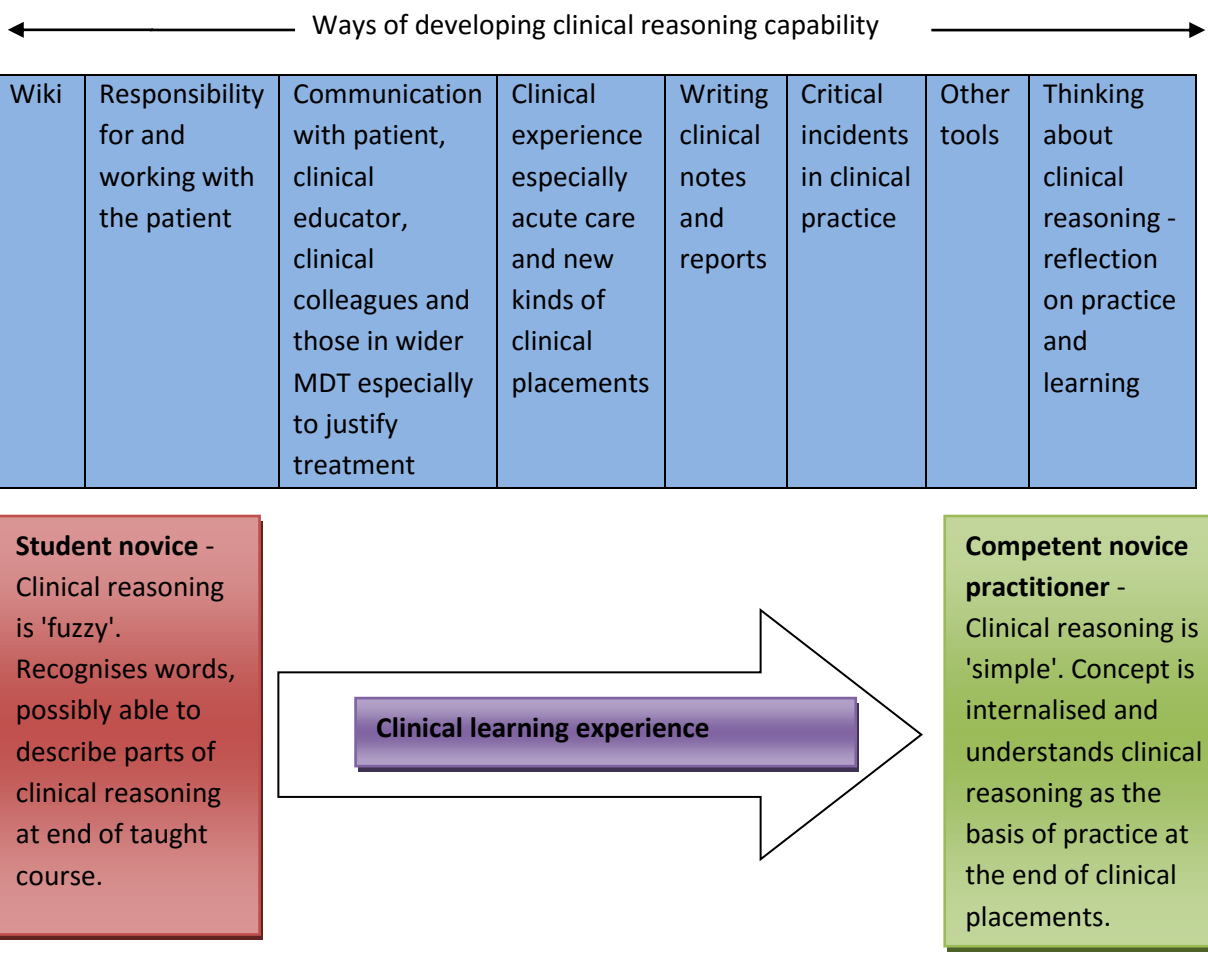


Figure 5.1 to show ways in which students developed their clinical reasoning capability

5.5.2. Wiki as a mediator of developing clinical reasoning capability

The final themes identified in the focus group and interview data focussed on the affordances of the wiki and how it helped the students develop their clinical reasoning. This links to Vygotsky's concept of semiotic mediation (Vygotsky, 1986). Studying how the wiki mediated the process of students developing clinical reasoning capability from their perspective gives insight into research sub-question three:-

3. What contribution, if any, does the case based wiki make to the development of clinical reasoning skills from the pre-registration physiotherapy students' perspective?

Table 5.8 illustrates the themes and codes derived from the initial focus group and interview data. The results will be presented using the themes as sub-headings.

Wikis as tool for learning	Wiki learning experience
Wiki used critical thinking skills	Learning with different pedagogies
Wiki taught finding and using information skills	Wiki and time
Wiki allowed practise of clinical reasoning	Wiki group work problems
Wiki focussed the treatment on the patient	Wiki as part of a packed curriculum
Wiki technology inconvenient	Wiki and reflection

Table 5.8 to show codes related to wiki as a learning tool and wiki learning experience from the initial focus group and interview data.

Table 5.9 shows the themes and codes related to the students' learning experiences identified from the second interviews. Once again, these codes and themes overlapped with those identified in the initial focus groups and interviews so similarities and differences in the data analyses will be highlighted in this section. The results will be presented with the themes as sub-headings.

5.5.2.1. Wiki as a tool for learning

Table 5.8 and table 5.9 show that there is some overlap between the coding of the wiki texts (Table 5.5, p70) and the focus group and interview data. The wiki text analysis showed that the students were using critical thinking skills in their discussion in the text. Christensen (2007) explained that sound critical thinking skills provide a firm basis for developing clinical reasoning skills. In the initial focus group and interview data, the students explained that the wikis had made them use their critical thinking skills:-

'...it's not like 50 shades of grey. And, um, they can only see it, if I could explain the paper that we were looking at wasn't the correct demographics for the patient and it was for people that didn't actually have the same condition and I was trying to explain that and they were saying yes, but it

says this, it was a very short paragraph that was relevant to our patient and I said the paper is not about that.' Sharon, interview one

Wiki as a tool for learning	Wiki used critical thinking skills Wiki taught finding and using information skills Wiki linked theory and practice (focussed the treatment on the patient) Wiki allowed practise of clinical reasoning Wiki technology
Wiki learning experience	Wiki and time Wiki and group working Wiki and reflection
Other taught course learning experience	Packed curriculum No emphasis on clinical reasoning
Placement learning experience	Lack of patient specific evidence based practice Enhanced and contextualised critical thinking skills

Table 5.9 to show codes and themes related to the students' learning experience from analysis of the second interviews.

The students also confirmed the findings from the wiki texts that the wikis had improved their skills of finding and using information to evidence practice:-

'Um, it was a useful process in terms of learning to use the systems in place to do the research, um, and getting used to reading the research papers and, you know, critically appraising them um, understanding sort of how, how to select a good piece of evidence and what's not a good piece of evidence so it was a good process in that sense,....' Sonia, interview one

There was confirmation that these skills, particularly using information to evidence practice had improved across the module:-

'I think, like at the beginning, well, I know for us, like we kind of searched for articles which kind of talked about the treatment, and like, say OK, say it works you using it but we didn't really went into details and it was more at the end that we kind of wanted to have the same age group, we wanted to have all the inclusion exclusion criterias which are fulfilled and kind of really specific for the patient, but at the beginning it was more kind of just finding evidence about the treatments but not really specific for the patients, it came like slowly from kind of case to case that we become more specific in our articles and evidence.' Sandra, focus group A

The initial focus groups and interviews transcripts confirmed that meaningful interaction had taken place in the wikis as students now recognised that they had been doing clinical reasoning and starting to develop clinical reasoning skills:-

'Um, yeah so the, obviously the wikis, were the biggest, er biggest part of clinical reasoning I think. As we said before, it was mentioned before but I don't really feel I put it into practice at all until we got into the wiki stage, which you know took some time to get used to.' Saskia, focus group, B

Sally saw the wikis as a stepping stone to clinical practice. This demonstrates how the wikis made a strong link between theory and practice for the students:-

'...the wikis was quite a nice platform after that, to then apply it to a patient and then you went on to do that properly on placement and I think, much as the wikis were hard work and there was definite negatives within the process I think it still, despite some of the negatives I think it provided a good platform to then go on and do that on placement, so yeah I wouldn't, I don't think I would necessarily change having done them, because I think it provided a good platform for going onto placement and doing it in practice.' Sally, focus group B

Sally's last comment also illustrates how the wiki focussed the treatment on the patient. By doing this, not only is a strong link between theory and practice being made but the wiki is also emphasising patient focussed care. This was different to other modules in the taught course where the focus of learning tasks designed to practice finding evidence was to evidence treatments rather than specifically considering whether a particular treatment and the evidence supporting that treatment would support the application of the treatment to a particular patient:-

'And we could choose, like our title in Neuro and then just kind of work around. You could change the patient if you couldn't find evidence ... I think the posters are like, as because beforehand like, when you've searched for something and when you didn't find anything, you can still change the title.' Saskia, focus group A

The analysis of the follow up interview data confirmed the previous data analyses. All of the codes identified in relation to this theme were present in the results from the analysis of the focus groups and first interviews. The students re-confirmed that the wiki helped to develop their skills for finding and using information and that they had used and developed their critical thinking skills as well as practised clinical reasoning in the wiki. The wiki linked theory and practice more than other parts of the course by focusing their treatment on the patient:-

'I think with the wikis was only when we actually had to, um, search for evidence which actually supported what you were doing compared to like text book and you can't just follow it what we learnt and we didn't kind of look, um, what was out there what was used, why we used it so I think it was different compared to the other modules because we actually like went outside from what we learnt in the textbook and in class and kind of had to look up why we are doing it and had to explain why we were doing it and not just valid, it's in the book or it's in the handout, so it was different compared to the other modules.' Sandra, interview two

Susan described the wiki as platform from which to jump into clinical practice:-

'...it's (the wiki) almost like a tool that facilitates everything involved with the patient, you know, from the subjective through to their assessment and treatment and to clinical reasoning, it gives you like a, I don't know, a base to jump off of, sort of thing.' Susan, interview two

She agreed with Sonia who thought that the wiki had given a shape to her attempts at clinical reasoning in practice:-

'Um, it (the wiki) helped, it helped um, it helped me sort of bring things together when I was clinically reasoning something, so I'd sometimes say to my educator well I think blah blah blah I know there's not the evidence base there but you know from x,y,z you know, I think this is the best because of da-da-da, you know so, um, it helped in, in me having an understanding of what can become clinical reasoning, it's, it's, it's quite a big thing, you know.' Sonia, interview two

These comments again show how the wiki makes a strong link between theory and practice both by putting the focus on the patient and giving a structure, which is similar to that used in practice, to help the students develop their thinking about clinical reasoning. The patient cases in the wiki 'forced' the students to focus on the patient just as they would do in practice. This had not been emphasised in other parts of the course. The code, 'wiki focuses the treatment on the patient' links with the code of relating theory to practice described in the theme of 'meaningful interaction' in the wiki text analysis. As the points in this section all overlapped with and confirmed the wiki text analysis, the fact that the wiki provided a way of helping students to use critical thinking skills, find and use evidence to inform practice, link theory to practice and allow the practice of clinical reasoning are important findings from this research. These findings give insight into how the wiki mediated the students learning about clinical reasoning. The iterative method taken for this study of data collection and analysis over a period of time also provides some rigour to the study findings by triangulating the findings of both methods of data collection.

In the wiki texts few issues had been raised about the wiki technology. For the wiki to successfully mediate the students' appropriation of clinical reasoning, the technology should be simple and easy to use. On analysis of the initial focus group and interview data, the students explained that they had had some difficulties with the wiki technology and found it inconvenient to use. The difficulty of working on and presenting the grids in the VLE was highlighted:-

'...doing those grids was just a nightmare on the UVLE - it just failed all the time and things disappeared and it looked awful.' Sharon, interview one

The asynchronous nature of the wiki discussion was highlighted as a problem:-

'If you've got a short space of time to do something you allocate yourself an hour in the evenings to do that, it's an hour where you want to say oh, I've just found this and this, someone else says

oh well, I've read that one too and it's not really what it says I thought it said, so it's a bit more, it's quick if you're on the UVLE, you've got to log-in, I don't know, it's not just up like that, it's not instant.' Sharon, interview one

The students thought that this may be because their peers did not log into the UVLE regularly but that an alert system may encourage them to do so:-

'It might be an idea, I don't know how you'd do it but every time someone commented something on the wiki you get sort of an e-mail sent to your Uni account so it'd be an update.' Susan, focus group A

These inconveniences with the VLE in which the wikis were created caused the students to make new wiki groups on Facebook, which was much more convenient and in constant use by the students. Sandra goes on to explain why in the following comments:-

'Everybody was on Facebook more than the UVLE so we had also our group on Facebook and kind of when we had meetings or something or had ideas we'd put it on Facebook .and once you post something on Facebook you get a notification so you can see automatically what they do.' Sandra, focus group A

The students had to learn to use the wiki technology, because this was the first time the students had used a wiki in their course. The students described how this created some problems with the learning:-

'Everyone got it (wiki technology) at different stages, whether that's because everyone wanted to or if they were being lazy or just didn't understand it, everyone , we weren't all on the same level I don't think.' Saskia, focus group B

In the analysis of the second interviews, some students confirmed their thoughts about the difficulties they had had with the wiki technology, although there was an acknowledgement that if time was taken to learn the wiki technology it worked satisfactorily:-

'...no if you take the time to actually sit down and look through it all then yeah it is relatively easy.' Saskia, interview two

How technology works in an educational environment is an important consideration.

Inconvenient, difficult to work technology or technology which does not work can make the learning experience difficult for students and make the technology a barrier to learning in its own right. These problems have been reported before (Sharpe et al, 2006b). Although we gave the students tasks to carry out to familiarise themselves with the VLE, they had to do this in their own time and there were no marks linked to these tasks. This may account for students' unwillingness to engage with the wiki. In this research it is interesting to note that students used a different

technology with which they were familiar and which they considered to be convenient, to replace the university VLE. This raises a question about the currency of the technology used in the university VLE.

5.5.2.2. Wiki learning experience

This theme links to Vygotsky's sociocultural theory because it supports a constructivist pedagogy within education (Smith, 1999). For the students in this research, the shift in underlying pedagogy could have become a barrier to learning in its own right (Cramphorn, 2004). Some of the findings from the initial focus groups and interviews support this notion. When students are used to a behaviourist pedagogy in which they learn information in a formal setting such as a lecture at a fixed time, for the information to be reproduced so that they can move to the next level in the course, a learning environment such as a wiki can seem less structured and time consuming to use. Students who were accustomed to a behaviourist pedagogy found the wikis time consuming in different ways. They considered that the time spent on finding supporting evidence for their treatments might have been wasted:-

'So I know there was an awful lot of time wast-, I wouldn't say wasted, I don't know if it's wasted, an awful lot of time searching to then sort of at the end of it realise there is nothing there but then you're searching and searching and searching and searching 'cos you think there must be something there because this is part of the module,...' Sonia, interview one

They considered that using the wiki was time consuming because of the inconvenience of logging into the UVLE:-

'If you've got a short space of time to do something you allocate yourself an hour in the evenings to do that, it's an hour where you want to say oh, I've just found this and this, someone else says oh well, I've read that one too and it's not really what it says I thought it said, so it's a bit more, it's quick if you're on the UVLE, you've got to log-in, I don't know, it's not just up like that, it's not instant.' Sharon, interview one

Sharon also pointed out that writing things in the wiki seemed time consuming and the asynchronous nature of the wiki made it harder to understand things:-

'...then writing things down, it got a bit long winded, um, and when you've got a question you want answered there and then it would make more sense to while it's fresh in your mind and to understand it, sometimes you write things down and you think what did I mean by that, I can't remember what my line of thought was actually, um, that was a bit frustrating.' Sharon, interview one

There was a feeling that the wiki was so time consuming it took time away from learning knowledge and practical skills for both the cardiorespiratory and other modules:-

'It was taking me away from what I was learning in the classroom, the other learning we had to do in the classroom environment, so in terms of subjects I felt I knew Cardio less than other subjects because I spent an awful lot of time on the computer just searching articles reading lots of articles you know..' Sonia, interview one

The students again raised the issue of time in the second interview data. The issues with time were similar to those raised in the initial focus groups and interviews and related to the time it took to learn to use the technology, the time it took to find evidence and how the time spent on looking for evidence in the wiki took time away from other learning of knowledge and skills in the cardiorespiratory module. The feelings of working in a VLE being time consuming and the difficulties associated with asynchronous learning have been reported before (Sharpe et al, 2006b). Clear deadlines were given to the students for completion of each of the wiki cases during the module. However the students reported that these deadlines were too long so they prioritised other work:-

'I think you put it (the wiki) off because there's other stuff going on and you prioritise it in the early stages as lower down because you know you've got all these, whereas if you only know you've got two weeks, you know, you give the exam the priority.' Saskia, focus group B

'Long deadline stops people working on wikis...' Sharon, interview one

These findings could also be indicative of students being more accustomed to superficial, assessment driven learning and fit with the behaviourist pedagogy with which the students were familiar. This unfamiliarity with a constructivist pedagogy was also reflected in students feeling unprepared for clinical placement. As the number of formal teaching sessions such as lectures and tutorials had been significantly reduced in the TEL module, so that students had time to work in the wikis, they felt that they had not learnt enough, another indicator that the students were more accustomed to learning lots of information that they could potentially reproduce on clinical placement:-

'I found we used a lot of the same techniques and treatments for most of the patients so all the other techniques we were learning about I kind of didn't really looked up anymore, so I was a little bit like, when now I go on respiratory I know all the treatments and techniques we put in the wikis but all the other stuff I kind of didn't looked up that much because I was like I don't need it for the exams, I don't know if it's going to be like a little bit of a problem.' Sandra, focus group A

Although students can feel anxious prior to starting clinical placements and this may manifest itself as the student feeling that their knowledge is inadequate, it also demonstrates that students may not be able to make the most of different learning opportunities because they do not understand how they can learn from these. For example, some students did not seem to value learning from other students, another feature of constructivist pedagogy:-

'I think within the university environment when you're working with other students, you're, if you're meant to be working effectively as a group you know and trying to come up with sort of treatments and those sorts of thing, um, because, it's, it's a group of people who are very inexperienced <LAUGHS> and have no clinical skills, it's quite hard to, you know, um, to actually, um, bring it together in a, in the sense ...um, but at the university, um, um, <PAUSE> don't know, possibly brain storming sessions with the lecturers <LAUGHS> and, and, having group discussions I don't know, ...' Sonia, interview one

Sonia also found the feedback from tutors left her feeling uncertain at times:-

'I think it was dependent upon which tutor was monitoring it and, um, each tutor obviously has a different experiences and different sort of methods of clinical reasoning which happens in the workplace as well, um, but I think that kind of confused students sometimes, sort of where to go with the wiki evidence.' Sonia, interview one

Being uncomfortable with uncertainty or several ways of doing something are also features of a student being used to learning 'true knowledge' and an underpinning behaviourist pedagogy.

Other students recognised that the wiki helped to develop self directed learning and that they had to adapt to a different way of learning:-

'And it's all about um, I think after year 1 and everything's kind of with Anatomy being so big, everything's sort of spoon fed to you really in year 1 and then in year 2 like a bolt out of the blue, they're like, off you go and wikis are one, a good example where you just have to do it yourself...' Saskia, focus group B

Although the students recognised that their learning needed to become more self-directed, the focus on self-directed learning still does not recognise that students may learn from their peers. Christensen (2007) explained that students need to be able to make the most of different learning opportunities to develop their clinical reasoning capability. Whilst these students may not have been maximising the opportunities available in a constructivist learning environment, Sarah does sum up how the students' learning needs to be flexible and adaptable to learn from different experiences:-

'... you got to make that transition again, like this is how we were in year 1, or this is what we were learning how, and then it's I suppose a bit like learning styles, some people get that transition straight away and others take a bit longer to think, oh this is what I should be doing..' Sarah, focus group B

Students expressed difficulties and anxieties with regards to group working. These manifested in different ways, such as unequal contributions to the work in the group, resulting in anger and stress:-

'I think the only struggle is that you're thinking OK I do understand this but when you are in a team and not everybody is contributing fairly and this is your exam that, it's a bit like, ok I know this is the real world but this is so important, that's it almost, almost ruin, it could ruin, you know ruin my exam and I might have to retake it that sort of thing and so that's the only...' Sarah, focus group B

Some students used very emotive language to describe their feelings about group work in the wikis:-

'The ones being punished are the ones that are working the hardest. Sarah, focus group B

'...you've got to get along with this and if you choose not to then you and other people will suffer and I think, unfortunately like you say it's the people that put most effort in that do actually end up suffering the most.' Sally, focus group B

These kinds of strong emotions in relation to TEL have been reported before (Sharpe et al, 2006b). They also indicate that the students on this course were not used to working in groups or collaboratively with each other, skills both of which are fundamental to clinical practice and to the development of clinical reasoning. In the second interview data, students confirmed the difficulties which they had experienced with group working in the wikis. Some of these feelings were still very strong:-

'When it triggered discussion it ended up being a bit, um, confrontational, certainly in our group. Er, so it probably wasn't, um, the best of experiences, didn't feel very collaborative it felt much more, um, somebody does all the work and the others didn't then want to chip in, it was difficult, um,...' Sharon, interview two

However, others could see the value of working in a group in the wiki after some clinical experience because the wiki gave the students the chance to practise working in a team as Sheila pointed out:-

'I think in terms of when we first started wikis, in class they said it was important to work in groups and you don't really understand it then and when you went on placement you find that everybody works in a team and then you often, even the seniors are like, not students and juniors, so they talk to one another and come up with different solutions and they encourage you to talk to them, if there's a problem then that comes up. If you see a patient and just say casually discuss it with someone on your team and justify what you was doing was correct so I guess it did help in terms of team working, you always hear it, but it's only when you go on placement that you do realise that we do work in a team, like all the time' Sheila, focus group A

Sally reiterated this sentiment in the follow up interviews:-

'That I think is the really hard element, is that, your perspective on it after it is very different to during it and I think your opinion of the wikis while you're doing them is overshadowing so many

other things simply just in terms of like group work, kind of the, which at the end of the day you need to learn and you need to know how to work within groups that don't necessarily work the way you want and all the rest of it.' Sally, interview two

She went on to reflect:-

'Yeah in a way considering what we've all chosen as a career it's quite surprising that we all struggled with group work so much.' Sally, interview two

The difficulties that the students had working collaboratively are an important finding because students will spend most of their working lives as physiotherapists collaborating with patients and other colleagues; group working skills need to be encouraged in the taught part of their course. The students need to feel comfortable in social learning environments, learning from others around them because this type of learning, which is a feature of constructivist pedagogies, reflects that in the clinical arena. This was illustrated in the ways in which students develop their clinical reasoning clinically, from their educators, other physiotherapists and members of the MDT.

In the wiki learning experience, individual students' contributions to the wiki were not awarded a mark in the module assessment. Tutors followed up students who were not participating in the wikis but the way in which this was managed seemed ineffective to some students. The students made several suggestions about how the tutors could 'force' students to participate with their groups or reflect contribution to the wiki in the assessment marks:-

'...if there was kind of a designated formal time with, that was overseen by the lecturer so those people felt a responsibility to stay and engage with the group, kind of forced engagement with your group which seemed really petty in a way but it has to but it has to get to that point but I think in reality, I think that's the only way to get some people focussed on the task.' Sally, focus group B

'Um, where the wiki was not formally assessed, you know as in, it was assessed individually at the end, um, I think in the Neuro poster there was more students pulled their weight a little bit more towards the end because, um, there was more emphasis on the grading.' Sonia, interview one

Therefore these kinds of collaborative learning experiences should be encouraged more for our students so that they learn important skills in relation to collaboration for working with patients, multidisciplinary team working and clinical reasoning.

The experience of the wiki came during a year where the curriculum was packed and this further contributed to the students' stress at the time:-

'The second semester seemed very jam packed. Like I know it was, it would be hard to change that but for each module it was sort of like get in and get out. You didn't really spend time and reflect on each aspect.' Susan, focus group A

The value of the wiki learning experience in developing clinical reasoning capability seemed to become apparent once the students had had a chance to reflect on their learning:-

'...and now reflecting back, you can actually see well, that the whole process has actually helped me develop skills in clinical reasoning, develop skills in researching not only for Cardio but in general . It's good to reflect back because, reflecting back, ah actually I did... that didn't make so much sense before but it does now.' Susan, focus group A

For some it was only during the interview that they realised how useful the experience was:-

'I think initially I'd have said no. Initially, but now that I'm talking about it (the wiki) I realise it did. Now that I'm actually talking about it to you I'm thinking about it, I realise it did help, looking at these papers, it actually helped.' Sheila, focus group A

Developing reflective skills was not emphasised in the course until students were about to go on clinical placement:-

'I think as well placements where you're asked to reflect more, that really brings out, makes you think about your clinical reasoning and why did I make those decisions, why you know sometimes if things go wrong as well and you reflect on that, you look back and think cor did I, did I clinically reason all that properly, where did I make my mistakes?' Saskia, focus group B

Saskia recognises in this statement how useful reflection can be in learning as well as its importance in developing clinical reasoning. This would suggest more emphasis should be placed on reflection on learning earlier in the course.

In the second interview data, having had time to think about the wiki as a tool for learning and reflect on their experience alongside their clinical learning, the students agreed that the wiki had been a useful tool to help with their clinical reasoning development:-

'...how I feel about wikis now I feel reasonably positive about the elements of it, um, and I kind of separate doing the wikis to the group work which wasn't as, you know, which was kind of, I guess you could say it was slightly a negative experience in some ways, still important but in a way negative.' Sally, interview two

The wiki learning experience seemed to be stressful and difficult for the students whilst they were immersed within it, because of problems with group working and time management. These difficulties may be linked to the shift to a constructivist pedagogy in the wiki and how the students were able to adapt to this. The lack of time in a packed curriculum and unfamiliarity with

reflection on their learning seemed to contribute to some of the problems the students described. Their feelings about the experience mellowed somewhat on reflection, once they had experienced some clinical placements and they could make links between the wiki learning experience and that on their clinical placements.

The final two themes emerged from the follow-up interview data. These related to the students' other taught course learning experience and their clinical learning experience. Separating the codes and themes into different learning experiences allows consideration of the students' learning experience in a dialectical manner. Vygotsky (1978) considered that higher mental functions, such as clinical reasoning as they develop, are in a constant state of dialectical change. Rather than focussing on contradictions Vygotsky (1978) was more concerned with the interconnectedness of phenomena and this along with the integration of opposites results in a synthesis of information within dialectics, that can lead to new or deeper understanding. By considering what the students felt they had learnt in their taught course learning experience, their wiki learning experience and their clinical learning experience, about clinical reasoning in a dialectical manner, new understanding may emerge about the contribution of each of these experiences in relation to how the students developed clinical reasoning capability. The data related to these themes will be considered initially followed by a summary of the learning experiences in tabular form.

5.5.2.3. Other taught course learning experience

The students contrasted their experience in the TEL module with that in other modules which they were studying concurrently in the taught part of the course. The code of packed curriculum was highlighted in the focus group and first interview data but was confirmed in this dataset:-

'I think what made it, probably made it worse and a bit more stressful, was the fact that when I actually sat down to really look into it, by that point, you know, everything else was starting to pile on top because it comes at a time when there's lots of other things going from different modules...' Saskia, interview two

As the students seemed to be taking more time to find relevant information for the wikis and completing the wiki grids, even though their face to face contact hours had been reduced in the TEL module, Saskia describes a stressful experience in terms of '*...everything else piling up...*' which could indicate familiarity with a more superficial type of learning often evident in behaviourist pedagogies.

The other code relating to the other taught course learning experience is the lack of emphasis on clinical reasoning. This code is confirmation of findings in the focus groups and first interviews. Clinical reasoning is embedded in the curriculum in this traditional course and so learning about clinical reasoning was largely left to the students:-

'Um, whereas to do that for NMS and Neuro it kind of had to come from you to think about that, obviously you did kind of exam practice and stuff like that but it wasn't as, because it didn't have the same structure, you could forget about certain elements um, for example, like kind of the reasoning, the clinical reasoning behind it, you might kind of decide what you wanted to do and kind of have the result of that but not necessarily have given enough consideration to the clinical reasoning, but I think that's less likely within the wikis.' Sally, interview two

'I don't think it (clinical reasoning) was, I can't really remember it being talked about much anywhere else.' Saskia, interview two

'Case studies in neuro were in a book, I don't think they came, they didn't come with reasoning, I'm pretty sure they didn't we had to do them for the exam so we had to learn about the condition....' Sharon, interview two

These findings support those of Christensen et al (2008) who has stated that learning about clinical reasoning is often left to the students themselves in traditional physiotherapy courses.

5.5.2.4. The placement learning experience

This is included as a theme in the results to show some key differences which the students highlighted between their clinical learning experiences and the rest of the course. Rather than explaining ways in which students developed their clinical reasoning whilst on placement, the two codes in this theme are related to critical thinking skills, often associated with the taught part of a physiotherapy course and patient specific evidence based practice. The students explained how being on placement enhanced their critical thinking skills. Sheila illustrates how being asked to provide an article for review by her clinical educator led to her thinking more about the currency of and more broadly about the research :-

'...when I was reading it they (the clinical educator)thought, there was something that was said, sometimes the patients are more lazy with nurses and they wondered if they worked more, if they worked harder with a physio as opposed to a nurse, so I found myself then looking to see if there was research on that, it was a challenge then on what was in this article ... 'cos if they weren't the same with nurses then something in that journal would've been not wrong but the evidence would not have been, a different conclusion, our conclusions would've not been accurate. So I just think about now if we use my patients I have to make sure it's up to date and then by looking for other evidence it would help me to critique this particular article more.' Sheila interview two

Other students explained how being on placement contextualised research and made pieces of research easier to understand. Susan explains how it can be easy to be critical of a piece of research from a theoretical point of view but experience in practice shows why a piece of research may have been done in a particular manner:-

'And also how the negative things or you know all the limitations of the study you know when you go out into practice and you see things happening and then you can relate it and you're like oh, this is probably why this was a limitation, because I'm seeing this happen with this, these set of people or whatever and then you can reason out why it would be a limitation and why it's also acceptable as a limitation and I think it just further enhances sort of everything to do with it.'
Susan, interview two

This type of contextualisation of practice can be linked to tacit knowledge (Eraut, 2000) which may be difficult to articulate or understand without clinical experience.

The last code in this theme relates to evidence based practice. After the emphasis which had been placed upon finding evidence to support the treatment for the patient cases in the wiki, the students had expected that they would have to do this in practice too. This had caused some anxiety to students as the focus groups and first interviews identified how they had confused clinical reasoning with evidence based practice. In the second interviews, several students demonstrated surprise when they explained how they had never been asked to find supporting evidence for the treatments which they had decided upon for a patient, even though they may have discussed a specific piece of research in relation to a type of treatment or a condition:-

'No, never. That never happened for me. I've heard of other people that had that come up, no I am, there's been placements where I have had in service like teacher training and that's been part of it perhaps a member of the team has found an article and we've all taken it home and had a read through it and then come back the next day and given our sort of thoughts and evaluated it. But it's never really, I've never really had that relating to a particular patient which actually would have been, I'll say it now because it's over, it would've been quite good to have done but no not....'
Saskia, interview two

'No that actually surprised me on placement I was never really asked for any kind of evidence based stuff, um...' Sally, interview two

Although this is not the focus of this research, this is a surprising finding and questions how the supervisors of the students in this research use evidence in their practice and the value that they attach to this.

5.6. Summary of how the students' different learning experiences contributed to their clinical reasoning development

Other taught course learning experience	Wiki learning experience	Practice learning experience
Other modules don't focus treatment on specific patient	Puts spotlight on the patient by focusing treatment on the patient	Responsibility for and working with the patient
Clinical reasoning is embedded in other modules	Puts spotlight on clinical reasoning to make it overt	Contextualises clinical reasoning
Clinical reasoning is talked about but not explained	Allows practice of and discussion about clinical reasoning	Experience in clinical arena especially acute care, new kinds of clinical placements and critical incidents develop clinical reasoning
No real structure for learning about clinical reasoning	Gives structure to learning about clinical reasoning	Use of other clinical reasoning tools and writing clinical notes and reports
Other modules ask for evidence to support treatment techniques but not for specific patients	Develops finding and using information skills and understanding about evidence based practice	Lack of patient specific evidence based practice
Considers critical thinking skills superficially (<i>Can change topics you are working on for assessment in similar modules if you can't find enough evidence</i>)	Develops critical thinking skills	Enhances and contextualises critical thinking skills
No specific discussion about clinical reasoning	Scaffolds learning about clinical reasoning through feedback and discussion with lecturers and peers	Communication with patient, clinical educator, clinical colleagues and those in wider MDT
No emphasis on group working	Asks students to collaborate and use group working skills	Uses and recognises the importance of collaborative working
Prepares students to reflect on clinical experience	Moves learning from superficial to deeper by starting to develop thinking about clinical reasoning	Uses meta-cognitive skills in relation to clinical reasoning especially reflection on practice and learning

Table 5.10 to show a dialectical comparison of different learning experiences and how these influenced the development of the students' clinical reasoning.

In order to summarise how the different learning experiences, the wiki, the other taught course and placement experiences influenced the development of the students' clinical reasoning capability, table 5.10 was constructed based on Vygotsky's theory of dialectics (Vygotsky, 1978), using results from the data analysis of the three stages of data collection in this research. This table summarises and illustrates a synthesis of the separateness and interconnectedness of the different learning experiences for the students in this research and helps to deepen understanding about how the wiki contributed to the students' clinical reasoning development. It shows how the wiki acted as a bridge for the students to link the theoretical part of the course with their clinical learning experiences. The table also highlights opportunities to develop learning experiences which will support the development of the students' clinical reasoning capability in the taught course and which have a congruence with clinical placement learning. For example learning experiences which place much more emphasis on developing and talking about treatments for specific patient cases through collaborative working could be developed in the taught part of this course.

The findings from the three stages of data analysis have shown how participation in the wiki influenced the development of the students' clinical reasoning. These findings and their implications are considered in depth in the discussion.

6. Chapter Six: Discussion

The discussion has been structured around the research sub-questions and the aims of this research in order to consider how the findings of this research answer the research questions and meet the research aims. The research findings are critically evaluated and compared to the literature, thus highlighting the original contribution of this research. The aims of the research are addressed to critically consider the implications of using a case based wiki to facilitate the development of clinical reasoning in physiotherapy students both at local level and in the wider context. Suggestions are made about how future research can build on the research described in this thesis. The credibility and rigour of the research and limitations are highlighted. Finally, a section on reflexivity is included to show how the position of the researcher may have affected the planning, conduct and analysis of this research and how the research process may have changed the researcher.

6.1. Answering the research sub-questions

In this section, the research findings will be used to answer the research sub-questions by summarising the key findings and relating these to the relevant literature. In doing so, the original contribution that this research makes to the literature will be identified. To understand how the wiki contributed to the students' clinical reasoning development, it is necessary to first understand what the students understood by clinical reasoning and then how they considered their clinical reasoning developed as the course progressed. Answering the research sub-questions in order provides this background to consider the contribution of the wiki.

6.1.2. Answering research sub-question one: What does the pre-registration physiotherapy student understand by clinical reasoning?

Summarising the findings from the wiki texts, the initial and follow up focus groups and interviews for the themes 'defining clinical reasoning' and 'understanding the concept of clinical reasoning' answers research sub-question one.

The findings from this research show that what the pre-registration students in this research understood by clinical reasoning changed and transformed as they progressed through the course. In the taught part of this largely behaviourist course, clinical reasoning was mentioned but never really fully explained. In this research this lack of understanding was illustrated by asking other students to fill in clinical reasoning information in the wiki or procrastinating about doing so

and students confused clinical reasoning with finding evidence for practice. The wiki brought attention to clinical reasoning for these students because they had to discuss and write down their clinical reasoning in the wiki but the concept of clinical reasoning was still poorly understood by the students and remained 'fuzzy' as they started their clinical placements. As the students started their clinical placements, they were able to define parts of clinical reasoning but not the whole. These findings are all supported by the work of Christensen et al (2008) who stated that learning about clinical reasoning can be left to the students themselves in physiotherapy pre-registration courses. For these students, the wiki learning experience brought attention to clinical reasoning more so than the other parts of the taught course. This is an original finding.

The 'fuzziness' of the concept of clinical reasoning may have been increased because the students in this research confused clinical reasoning with evidence based practice. As the students had been asked to find evidence to support the treatments that they suggested for the patients in the wiki cases, they understood that providing evidence to support practice was clinical reasoning. Some students were very worried about having to provide evidence for treatment once they were on placement.

The students in this research understood clinical reasoning to be 'patient focussed' after only one or two clinical placements. Putting the patient at the centre of practice is a facet of expert physiotherapy practice (Jensen et al, 2000). This finding is in contrast to Hendrick et al (2009) and Cruz et al (2012) who found that students' clinical reasoning was largely 'clinician centred' even towards the end of their physiotherapy courses. This may be because the wiki linked theory to practice by using patient cases, thus focussing on the patient.

As the students progressed through their clinical placements, they were able to discuss and explain clinical reasoning and how they had developed their clinical reasoning capability, until they reached a point where clinical reasoning had become 'simple'. In this research students demonstrated this by clinically reasoning in an autonomous, responsible, accountable manner and were comfortable doing this in the changing healthcare environment (Higgs and Jones, 2008). This seemed to be when the students had transformed their understanding of clinical reasoning and internalised the concept (Vygotsky, 1978). The students understood clinical reasoning not only as a justification of their own practice but also as the basis of professional practice (Higgs and Jones, 2008). This occurred at different stages for the students throughout their learning experiences and may be related to their ability to adapt to and learn from different experiences and situations and the kind of clinical learning experiences which they encountered as suggested

by Christensen (2007). This ability to adapt to the clinical learning experience may be because the students had had the experience of participating in the constructivist learning experience of the wiki, which has congruence with the type of learning that usually takes place in clinical practice, where communication and collaboration with others are key.

6.1.3. Answering research sub-question two: What is the process of development of clinical reasoning from the pre-registration physiotherapy students' perspective?

The process of development of clinical reasoning is inextricably linked to understanding clinical reasoning and how the wiki contributes to this for these students so there will inevitably be some overlap in the answers to these research questions. However, summarising the findings from the initial and follow up focus groups and interviews for the themes 'understanding the concept of clinical reasoning' and 'ways of developing clinical reasoning' as well as considering the themes related to 'taught course, wiki and placement learning experiences' answers research sub-question two.

The findings of this research show that clinical reasoning was embedded in the taught part of the physiotherapy course. It has already been stated that from the students' point of view, clinical reasoning was mentioned and the concept was talked about but never fully explained (Christensen et al, 2008), that the wiki learning experience put the spotlight on clinical reasoning for these students and that students developed a partial understanding of the concept of clinical reasoning by participating in the wiki. Clinical reasoning developed most rapidly as the students participated in their clinical learning experience. This gave context to the concept of clinical reasoning (Eraut, 1994).

From their clinical learning experiences, the students explained several ways in which their clinical reasoning developed. Taking responsibility for the patient as the students began their clinical placements was the first of these. This has not been highlighted before as a finding in research relating to the development of physiotherapy students' clinical reasoning. This may be because the focus of this research also considered how students developed their clinical reasoning rather than just their perceptions or understanding of clinical reasoning (Hendrick et al, 2009; Cruz et al, 2012). Although it links with the finding of caring and commitment as a core dimension of expert practice by Jensen et al (2000), taking responsibility for the patient for a student also assumes a burden of responsibility. This finding is novel and warrants further investigation.

As the students' clinical placement learning progressed, rather than feeling completely responsible for their patients, which would indicate a clinician centred focus to treatment, the students had recognised that they needed to work or collaborate with their patients to try and achieve the best outcomes for the patient. This is a critical step in developing clinical reasoning capability and has been recognised by Jensen et al (2000) as a step towards expert practice. This finding contrasts with other research investigating student and novice practitioners' clinical reasoning, (Hendrick et al, 2009; Cruz et al, 2012) and may represent a critical learning transition in becoming a competent novice practitioner.

Communicating about clinical reasoning was another way in which the students in this research identified that developed their clinical reasoning. Initially this was by communicating with their patients, educator and other physiotherapists to check and confirm their clinical reasoning and justify their treatments. This developed into using their clinical reasoning to explain and justify whether or not physiotherapy treatment would be suitable for a patient to other members of the MDT or challenge the clinical reasoning of their clinical educator in relation to a particular patient. The importance of communication about and articulating clinical reasoning to others who may be mentors as a way of developing clinical reasoning, has been previously been highlighted by Ajjawi and Higgs (2007; 2012) in their research with qualified and experienced physiotherapists. The students in this research had other ways of developing their clinical reasoning in common with the participants in Ajjawi and Higgs' research. These included writing notes and reports (another way of articulating reasoning), critical incidents and reflecting on clinical reasoning both in the clinical environment and even participating in this research. The findings of this research support those of Ajjawi and Higgs (2007; 2012) but also shed new light on how physiotherapy students develop their clinical reasoning.

Clinical experience in acute care placements, which gave the opportunity for repeated practice of clinical reasoning (Eraut, 1994; Masley et al, 2011) and new and unfamiliar environments, which had not been covered in depth in the taught part of the course focused the students' clinical reasoning and made it explicit in relation to patient treatments. As they were thinking about their clinical reasoning in this way, they were using meta-cognitive skills to evaluate and reflect upon their treatments and the process by which they had arrived at the treatment. For physiotherapy students, this is a novel finding and may relate to the clinical areas which have been the focus of clinical reasoning research involving physiotherapy students. Previous research has been in the musculoskeletal area of practice (Cruz et al, 2012; Hendrick et al, 2009).

Once they had started their clinical placements, students identified reflection upon their clinical reasoning as a way of developing and improving clinical reasoning. Reflection on practice is well recognised as central to the evolution of expert professional knowledge (Jensen et al, 2000; Resnik and Jensen, 2003). Both Terry and Higgs (1993) and Jensen et al (2008) emphasise the importance that should be placed on encouraging students to reflect on their learning and allowing time for this in their course. Our students had only had reflection emphasised in their course just prior to starting their clinical placements. This meant that the students were using reflection in the clinical arena but may not have been doing so for their taught course experiences. In this research, little reference was made to reflection on the wiki learning experience as it occurred. Only one participant talked about writing down their clinical reasoning in the comments section of the wiki and how this allowed them to reflect more easily on what they and others had written about clinical reasoning. This supports the findings of Dal Bello-Haas (2013) whose participants valued being able to write in the wiki and the asynchronous nature of participation because it allowed time to reflect on their learning.

When students were asked to reflect on the wiki learning experience in the interviews and focus groups for this research, after they had spent some time on clinical placements, they started to realise how much they had learnt about clinical reasoning in the wiki and how it had acted as a platform to give some structure to their clinical reasoning on placement. This was in terms of practising using information they were learning to clinically reason about a patient case. Eraut (2000) and Ajjawi and Higgs (2008) have both emphasised how important this is. The wiki structure helped the students organise their thoughts to clinically reason in practice. This may relate to the early development of a knowledge network (Boshuizen and Schmidt, 1992).

Flannery Wainwright et al (2010) explored the difference between novice and experienced physiotherapists' use of reflection in decision making. Both groups reflected on their interaction with the patient once the treatment was over, and reflected how prior experience may influence future actions. However only the experienced physiotherapists reflected in action and adjusted their interventions accordingly. Students in this research may have only been using reflection in a similar way to both groups in Flannery Wainwright et al's research. The use of reflection about learning experiences in the taught course should be encouraged, not just once the experience is completed but also whilst the students are in the learning experience. The concept of reflection on learning and professional practice and how this is developed should be introduced to physiotherapy students at the start of their taught course. This may help students to understand better how they are able to learn from the diverse experiences which they are likely to encounter

in the future. Although this suggestion is not new (Terry and Higgs, 1993; Jensen et al, 2008), reflection and how it is used in the taught course warrants further investigation.

The other way in which the students in this research developed their clinical reasoning was by the use of other tools to help the development of clinical reasoning such as standardised assessment forms and a clinical reasoning tool which reflected the structure of the wiki. The clinical reasoning literature discusses pattern recognition as a way in which expert practitioners clinically reason in case presentations (Groen and Patel, 1985; Payton, 1985) and this research suggests that tools designed to encourage clinical reasoning including the wiki helped students to provide a framework for the basis of their reasoning in terms of information organisation and pattern recognition.

Clinical reasoning is a complex, dynamic and multi-faceted process, which takes time to develop. By investigating students' clinical reasoning whilst they were developing their clinical reasoning, this research has shown some important ways in which students developed their clinical reasoning. The results of this research reflect the findings of Ajjawi and Higgs (2007; 2008). Episodes which raised their participants' awareness of clinical reasoning such as communicating about reasoning with others, critical incidents and participating in their interviews resulted in rapid learning about clinical reasoning for their participants. Their findings alongside those of Masley et al (2011), who showed how rapid, collaborative decision making in acute care requires repeated clinical reasoning, explain how the students in this research developed their clinical reasoning whilst on placement. This research is the first to show these similarities to Ajjawi and Higg's work (2007; 2008) in how physiotherapy students developed their clinical reasoning capability and so offers an original contribution to knowledge. Ajjawi and Higgs (2008) proposed that collaboration and communication is at the centre of developing clinical reasoning and suggested the use of constructivist TEL as a way of helping students to develop their clinical reasoning because clinical placement learning appears to mirror constructivist TEL. The findings from this research suggest that this may be the case. Other research which has looked at physiotherapy students and clinical reasoning (Hendrick et al, 2009; Cruz et al 2012) has focussed on what physiotherapy students understood by clinical reasoning rather than how they had developed their clinical reasoning. These findings related to ways of developing clinical reasoning from the physiotherapy students' perspective are therefore novel, although they have a strong link to the work of Ajjawi and Higgs (2007; 2008).

6.1.4. Answering research sub-question three: What contribution, if any, does the case based wiki make to the development of clinical reasoning skills from the pre-registration physiotherapy students' perspective?

To answer this research question, summarising the research findings from the wiki texts, initial and follow up focus groups and interviews for the themes 'ways of developing clinical reasoning' and 'wiki as a tool for learning' as well as considering the themes related to 'taught course, wiki and placement learning experiences', provides insight. It has already been stated in answering research sub-questions one and two that the findings from this research showed that the wiki put the spotlight on clinical reasoning for the students in this research, even though the concept of clinical reasoning was not fully explained to the students during their taught course (Christensen et al 2008).

The research findings show that the wikis allowed the students to practice and discuss clinical reasoning. Terry and Higgs (1993) and Eraut (2000) suggested that practising clinical reasoning prior to clinical placement may be a way of developing clinical reasoning capability. For these students, the research findings confirmed this suggestion because they show that participation in the wiki allowed them to practice clinical reasoning. The students were using different kinds of clinical reasoning in the wikis including diagnostic reasoning (Edwards et al, 2004), procedural reasoning (Mattingly and Fleming, 1994) and patient centred reasoning (a category defined in this research where the circumstances of the patient in the case were considered in treatment). The reasoning category which appeared the most frequently in the wiki text analysis was patient centred reasoning which supports the notion that the wiki learning experience puts the focus on the patient. Diagnostic reasoning, which is associated with clinician centred reasoning (Edwards et al, 2004) and has been shown to be the kind of reasoning in which students engage (Hendrick et al, 2009; Cruz et al, 2012) appeared less frequently in the wiki texts, possibly because the patient's salient signs and symptoms were available in the patient case or because of the nature of cases in cardiorespiratory practice. This could be viewed as an advantage because the students focussed more on the patient themselves, a construct associated with more advanced clinical reasoning skills (Jensen et al, 2000). Although the students could not collaborate with the patient in the cases, the wiki cases focussed the students' treatment on the patient making an important link between theory and practice. The research findings related to different kinds of clinical reasoning emerged from the wiki text analysis. However the students recognised that the wikis put the focus on the patient from their perspective and this finding is something which was different from the learning experience in the other parts of the taught course. This is an original finding.

The fact that the wikis allowed practice of and discussion about clinical reasoning showed that the learning task was authentic (Bower et al, 2006), and that the task had engaged the students in meaningful interaction (Woo and Reeves, 2007). Although the students appeared to be engaging in meaningful interaction in the learning tasks which would support the development of clinical reasoning, from the analysis of the wiki texts, it was evident that there was some uncertainty about the concept of clinical reasoning amongst the students. This uncertainty was confirmed in the analysis of the focus groups and first interviews as the students described clinical reasoning as a 'fuzzy' concept. The wiki seemed to be promoting meaningful interaction for these students but it must be questioned whether the interaction in the wiki was meaningful in relation to developing clinical reasoning skills as the students did not completely understand what this was. The findings in this research in relation to how the wiki allowed meaningful interaction to develop clinical reasoning skills make an original contribution but it should be acknowledged that students need to have a clear understanding of the concept of clinical reasoning for the interaction to be completely meaningful in the wiki. This warrants further investigation.

In these research findings, the students were emphatic that the wiki learning experience had helped to develop their finding and using information and critical thinking skills because the students were asked to evidence their treatment choices. Solomon and Baptiste (2005) and Christensen et al (2008) stated that the development of generic thinking and learning skills are necessary to form the basis of clinical reasoning. The analysis of the wiki texts showed that the students were utilising the critical thinking constructs of analysis and evaluation whilst also developing their knowledge in context by developing their understanding and these findings were confirmed in the interviews. Developing critical thinking skills in this way moves learning away from superficial rote learning which is common in behaviourist environments. The contextual nature of the critical thinking development by using patient cases in the wikis is important because context has been shown to play an important part in the development of tacit knowledge (Eraut, 2000).

Edwards et al (2004) defined a model of clinical reasoning in physiotherapy practice which showed a dialectical relationship between interpretative thinking about the patient's story, knowledge in relation to the patient's diagnosis and the scientific evidence (empirico-analytical thinking). The students in this research showed patient centred reasoning, reasoning focused on the patient's story, development of their physiotherapy knowledge in context by developing their understanding and development of their understanding of and ability to evaluate the scientific

evidence. As the students linked these areas together, evident in the data analysis, they were starting to develop skills in dialectical reasoning.

The authenticity of the task may also be questioned in relation to asking students to evidence their treatment choice. The students in this research understood from the wikis that it would be important to evidence their treatment choices for patients in practice. However they found that in practice they were rarely and for some students never asked to evidence their practice for particular patients. Sackett et al, (1996) described best medical practice as that which would allow patients to be active participants in decisions about the best treatment for them, based on current research evidence and the clinical experience of the medical practitioner. This description of evidence based practice has strong links to the dialectical model of physiotherapy clinical reasoning proposed by Edwards et al (2004) and is considered relevant in current practice. However from this research, there seems to be a divide between theory and practice in the way in which research may be used in practice. Although there is a body of evidence in this area, this warrants further investigation in the current health climate.

To develop their clinical reasoning, students need to not only obtain appropriate information but to organise the information in a usable way. The ways in which information is organised can become patterns that may be used in clinical reasoning strategies. Although the clinical reasoning literature discusses pattern recognition as the way in which expert practitioners recognise patterns in case presentations (Groen and Patel, 1985; Payton,1985) it has already been stated that this research shows that the wiki helped students to provide a framework for the basis of their reasoning in terms of information organisation and pattern recognition. This was apparent in both the wiki texts and interviews when the students talked about the wikis as providing a platform for their reasoning in practice in that the wiki gave a shape to how the students could reason clinically. This finding is supported by Ladyshewsky and Gardner (2008) and Newton Scanlan and Hancock (2010), who showed that organising thoughts in a blog and providing a framework for clinical reasoning helped develop their students' clinical reasoning ability whilst they were on placement. These findings support the notion that providing a framework for the learning experience enhances the development of clinical reasoning skills.

From the wiki text analysis, it was evident that the students' learning about clinical reasoning was being scaffolded as they participated in the wiki. The students sought feedback from and gave feedback to their peers. Some examples of this include their understanding of information, the suitability of treatment for a patient and whether evidence was appropriate to support practice. The students scaffolded each other's learning by praising others as they gave feedback and also

challenging their peers, for example, to try and find information. Tutors gave feedback in the wiki on student work and the students sought feedback and clarification from tutors about their treatment decisions and the suitability of research to support these decisions. Not only did the wiki scaffold formal learning but the way in which the students communicated with each other within the TEL environment required the students to act professionally. This gave the students the chance to practise communicating in a way which was appropriate for the recipient, a skill highlighted by Ajjawi and Higgs (2008) as being important in the development of clinical reasoning.

Although scaffolding of learning clinical reasoning was occurring in the wikis, the findings indicate that the students did not perceive that their learning was being supported. This may be because just as the students did not understand what clinical reasoning was from the taught part of the course, they did not understand the concept of scaffolding. The students did not understand that they could learn from each other or that the tutors were trying to facilitate knowledge construction rather than tell the students the answers (Cramphorn, 2004; Woo and Reeves, 2007). The findings of this research show that some students recognised that the wiki helped to develop self-directed or other ways of learning and the benefits of this but that the students did not understand the constructivist learning principles underpinning the wikis and were therefore not able to maximise the learning opportunity Christensen (2007), even though all the students involved in the focus groups and interviews participated in the wiki and agreed that you needed to actively participate in the learning experience to learn from it. It is therefore difficult to draw conclusions about those who did not participate and how the wiki influenced their learning. This is an area which would benefit from further exploration.

The findings from this research suggest that the students were not comfortable working in a group or a collaborative manner. This was shown in the interview data as the students used emotive language to describe their experiences of working in wiki groups. These kind of strong feelings have been described before in relation to students who are accustomed to a behaviourist pedagogy starting to learn in a constructivist environment (Sharpe and Benfield, 2005). The findings from this research also show that some students recognised the benefit of working collaboratively in a wiki group because they were using the skills they had learnt in their clinical work. These findings have important implications for students in healthcare professions and collaborative, group working learning experiences should be encouraged in these courses.

6.2. Critical consideration of the aims of this research

The last section showed how the findings of this research answered the research sub-questions. The aims of the research will now be considered to critically assess the implications of using a case based wiki to facilitate the development of clinical reasoning in physiotherapy students. There were three aims for this piece of research which will be used as sub-headings in the next section of this chapter.

6.2.1. Aim one: To investigate and understand whether, and if so how, participating in a case based wiki prior to clinical placement helps to develop clinical reasoning from the pre-registration physiotherapy students' perspective.

There is inevitably overlap between the research questions and the aims of this research. Answering the research sub-questions above goes some way to addressing this aim. The findings of this research show that for these students participating in the case based wiki did help to develop clinical reasoning from the students' perspective. However the true benefits of participating in the wiki as a way of developing clinical reasoning capability were not clear to these students until they had participated in some of their clinical learning experience. This corresponded to the students developing a clearer understanding of the concept of clinical reasoning.

Other research which has shown a link between participating in different TEL constructivist environments and development of clinical reasoning skills, has shown evidence of clinical reasoning or improved clinical reasoning ability when the texts from the TEL environments are analysed (Newton Scanlan et al, 2006; Newton Scanlan and Hancock, 2010; Tan et al, 2010). None of these studies considered the perspective of the physiotherapy students in their research so the studies are similar to the analysis of the wiki text in this research. Westwater-Wood and Dennick (2011), Snodgrass (2011), Preston et al (2012) and Seif et al (2013) all used questionnaires to assess TEL learning experiences to help develop students' clinical reasoning and found that the physiotherapy students in their research agreed that their clinical reasoning skills had improved. Only Snodgrass (2011) used focus groups as well as a questionnaire in her research. These seemed to be used to elicit the students' thoughts about the TEL learning experience rather than how the wiki had helped to develop the students' clinical reasoning (Snodgrass, 2011). Therefore none of these pieces of research explain how the students felt that their clinical reasoning capability had improved. The students' perspective in this research gives new information about how the wiki

influenced their clinical reasoning capability by drawing attention to clinical reasoning, focussing on the patient and providing a framework upon which to base their clinical reasoning.

6.2.2. Aim two: To critically assess the implications of using a case based wiki to facilitate the development of clinical reasoning in pre-registration physiotherapy students prior to clinical placement.

It is clear from this research that there is value in using a TEL constructivist learning environment to help develop students' clinical reasoning capability. However the opportunities for learning clinical reasoning within the wiki learning experience may not have been maximised for this group of students who were used to a behaviourist pedagogy. The implications of this will be considered here.

6.2.2.1. The implications of embedding important concepts into a course

If the students had had a better understanding of the concept of clinical reasoning as they embarked upon their wiki learning experience, they may have developed their clinical reasoning capability more before they started their clinical placements. A concept such as clinical reasoning, which is the basis of professional practice (Higgs and Jones, 2008), may be embedded within physiotherapy courses but this should be in an overt manner. Not only should physiotherapy students be introduced to the concept of clinical reasoning from the start of their course, but they should also understand how the foundations for developing clinical reasoning, such as the development of critical thinking skills, link with the development of clinical reasoning. The development of clinical reasoning should be one of the key foundations upon which pre-registration physiotherapy education is built. Physiotherapy students need knowledge and skills but they also need guidance about why they are learning these and how the ways in which they are learning these link to clinical practice. The ways in which the students learn in the taught part of the course should reflect and have a congruence with how the students learn in clinical practice.

Ajjawi and Higgs (2008) found that physiotherapists in their research did not distinguish between learning to clinically reason and learning to be a physiotherapist. They referred to learning to clinically reason as being a journey of professional socialisation through which the norms and values of a profession are socially constructed and internalised through active participation in learning to develop professional identity. Richardson (1999) explained that professional socialisation is a learning journey which can start before a student starts the physiotherapy course and goes on after the student has graduated. Professional socialisation can take place by

participation in a community of practice. Lave and Wenger (1991) emphasised the importance of participating in a community of practice to learn to become a full member of that community. The findings of this research show that the case based wiki is a suitable way to assist the process of professional socialisation in the taught part of the course especially if the wiki group functions as a community of practice. Moule (2006) found that health care students could develop essential elements of a community of practice such as joint enterprise, shared repertoire and mutual engagement, when working in a constructivist, case-based learning experience. The wiki text analysis showed that students were doing and discussing clinical reasoning in the wiki, supported by feedback from a tutor in a professional manner. The findings from this research show that students may not have understood this to be learning about clinical reasoning as they were doing it but that explicit links need to be made by the module team between learning clinical reasoning and ways of doing it.

Active participation in a community of practice has been described by Wenger (1998) as necessary for learning to take place. Students in this research participated in the wiki and agreed that you needed to actively participate in the learning experience to learn from it. Clouder (2003) argued that professional socialisation cannot happen by passive internalisation but that some individual agency is required. This research shows that not all students actively participated in the wiki to the same extent. This was demonstrated in the initial analysis of the wiki texts to see how many times each student had commented in the wiki and confirmed in the focus groups and interviews. Some students had been much more active in contributing to the wiki than others and had thus played a much larger role in scaffolding the other group members' learning.

There may be many reasons why a student does not actively participate in a TEL. Woo and Reeves (2007) described how students who are used to behaviourist pedagogy may not realise how much they can learn from participating in a socio-constructivist learning environment. Elgort et al (2008) support this finding because students in their research thought that working in the online environment was not as academically rigorous as working in a traditional manner. Minocha and Thomas (2007) found that students were reluctant to change or disagree with the contributions of other students to their wiki. For the wiki to be a successful way of learning clinical reasoning, more attention should be paid to the students who do not regularly contribute to the wiki to encourage their active participation, by helping them understand how participation can benefit their learning and development. Passive reading of the information in the wikis and not contributing to the learning task will not lead to development of clinical reasoning skills. Online participation has been conceptualised further by Hratinski (2009) who considered that online

participation included taking part in the activity, maintaining relations with others, communicating in an appropriate and meaningful way and is supported by engaging activities. The students participating in the wikis were engaging in this manner. However those students who were not, missed out on a valuable learning opportunity, which seemed to link to poor module assessment results.

In both wiki groups in this research, students who participated least in the wiki obtained the lowest assessment marks in their group whilst students who participated most obtained the highest marks. This trend repeated itself in the marks of the whole cohort. Five students on this cohort failed the assessment. Four of these made an average of two comments (range 4 - 0) in the wikis. The other student who failed the assignment made nine comments, but this student failed the assessment due to handling the patient model in an unsafe manner. Eight students received more than 70 percent in the module assessment and made an average of 22 comments in the wikis (range 13-36). Although no inferential statistical tests were carried out on the cohort module results, there appears to be a link between low levels of participation in the wiki resulting in low module results and vice versa. These findings warrant further investigation.

The findings of this research show that the wiki helped the students develop their skills for finding information and their critical thinking skills. A question that arises from this research is whether the students understood how critical thinking skills support clinical reasoning and whether this link was ever clearly made. Some students in this research suggested that they were wasting time searching for and reading research articles in the wiki learning experience, so one may assume that this is another embedded feature of the course. Edwards et al's (2004) model of dialectical clinical reasoning illustrates the importance of learning about research paradigms and being able to critically evaluate information of different types. Linking a model of clinical reasoning such as this to the wiki learning experience may highlight the importance of developing skills to critically evaluate and analyse research.

The findings of this research show that the wiki may have contributed to the students' understanding that clinical reasoning is patient focussed and collaborative. Jensen et al's (2000) model of the philosophy of physical therapy and how the core dimensions of physical therapy practice link to this should also be considered as a model upon which the philosophy of a physiotherapy course is built. The experts in their study were peer designated and so it could be considered that this would be how a physiotherapist would wish to be viewed by their peers. The findings of this research show that the wiki linked theory to practice by focussing treatment on

the patient and clear links could be made for the students between expert practice and how the wiki links to this.

Several suggestions have been made here about improving the students' wiki learning experience. From the point of view of the module team, all these suggestions could be implemented to improve the students' wiki learning experience and to help the students develop their clinical reasoning further. However clinical reasoning is a feature of all physiotherapy practice and as the findings of this research show, some students did not link the concept to other areas of physiotherapy apart from cardiorespiratory practice, because of its focus in the cardiorespiratory module. These suggestions would be better embraced by the whole of the physiotherapy team involved in the delivery of the BSc (Hons) Physiotherapy course. Making these links in terms of critical thinking and how it links to clinical reasoning or emphasising clinical reasoning so that students gain a better understanding of the concept in the learning experiences which other members of the physiotherapy team devise for students, may be relatively easy for the physiotherapy team to agree to. A larger shift in the underlying pedagogy of the course to a more constructivist pedagogy, which would emphasise social and collaborative aspects of learning more which are important for the development of clinical reasoning, may be much harder to achieve. This may be because of the lecturers' own values and beliefs about learning or because our physiotherapy course seems relatively successful anyway so why change what appears to be going well?

A major measure of the relative success of undergraduate courses in the United Kingdom is currently the National Student Survey (NSS) (HEFCE, 2015). The NSS collects students' opinions about their courses in their final year of the course. The results are freely available and published widely in the media. The results of this survey are very important to institutions in the current economic climate for their value in marketing courses and attracting students. Currently in this institution, there is a strong emphasis on the NSS and improving the student experience on the courses in the university. The BSc (Hons) Physiotherapy course in this research scores very highly, usually above 95% satisfaction, in the NSS and is normally one of the highest scoring courses in the institution. Each year a small number of students report that they did not like the wiki experience because of the group work, in the qualitative comments of the NSS. These comments are diminishing in number over the years but the module team have been asked to review the value of the wiki learning experience in relation to the course. This highlights how a learning experience, which has been shown in this research to make a contribution to the development of the skills which a student requires for professional practice, is vulnerable because of the political

climate and highlights the necessity of explicitly explaining to students what they are learning, why it is important and why they are learning in a particular way.

6.2.2.2. The wiki technology

For students to participate in a wiki, the technology must be easy to use. Difficulties with technology can become a barrier to learning in its own right. Some of the students in this study reported some difficulties with the wiki technology such as problems with formatting information, losing information and the time it took log in to the VLE to see how the wiki had been updated. Other students found the technology simple to use once they had spent time learning to use it. These findings are consistent with previous research into the use of wikis with physiotherapy students (Snodgrass, 2011). One student in this research explained how their wiki group had set up a Facebook page to discuss the wiki cases because they were so fed up with the time it took to check and access the university VLE. She commented that students are on Facebook all the time and that notifications when Facebook updates make it easy to know when new information has been added. These comments about the ease of use and access to different technologies are important for Universities to consider when investing in VLEs.

The annual EDUCAUSE survey (Dahlstrom and Bichsel, 2014) which explores students' technology experiences and expectations showed that students have favourable attitudes towards technology and technology is embedded in their lives. They value access to information about their studies on mobile devices, anytime and anywhere, but still need guidance about how to use technology in meaningful and engaging ways for their studies (Dahlstrom and Bichsel, 2014). Although most of the students in this research had experienced a blended learning environment, the way technology is being used in education is still developing and this survey highlights how the difficulties which exist with introducing TEL may exist for some time to come. This research is supported by Thiele et al (2014) who surveyed physiotherapy students about their perceptions of educational technology in the classroom. Students liked technology in the classroom but were only using it in a limited fashion and were starting to recognise that technology could be a distraction from learning activities going on in the classroom.

The complexity of introducing TEL experiences and the many different ways of doing this is an ongoing puzzle. The findings of this research support the notion that technology should be easy to use and have appropriate affordances to meet the learning outcomes of a learning experience. How the technology changes a learning experience, for example the underlying shift in pedagogy

and the reasons for making these changes, for example so that the learning experience has a congruence with other learning the students will experience, must be made explicit.

6.2.2.3. *The shift to constructivist pedagogy*

This research highlights the difficulties students, who are accustomed to traditional ways of learning, encounter when a constructivist learning approach is introduced into their course. The students in this research reported difficulties within the wiki learning experience in relation to group working and to time in several different ways. The students in this research reported some strong emotions in relation to working in groups with each other. Some felt like they were being 'punished' because they felt that they were having to do the work of group members who were not pulling their weight or 'freeloading' on the back of work of others. It has already been stated that explaining to the students why and how they would learn in a constructivist learning environment may have limited some of these problems but the shift to the constructivist wiki learning experience had a major impact on the students not just because of the pedagogy shift but also because the cardiorespiratory module used TEL, was case based and the students were asked to evidence all the treatments they decided to use, all whilst understanding and learning new information in the cardiorespiratory field. Moule (2007) developed a conceptual model which she called 'the e-learning ladder' to reflect health students' experiences of e-pedagogy. Although the ladder is based around e-learning, the lower rungs of the ladder reflect instructivist or behaviourist types of e-learning with the higher rungs of the ladder placing more and more emphasis on constructivist e-learning. The highest rung of the ladder reflects students participating in constructivist e-learning environments which could be considered to have the features of a community of practice (Wenger, 1998). Attention is brought to this model because the students in this research were unfamiliar with different types of e-learning, particularly those represented in the middle to top of Moule's (2007) ladder before they embarked on the wiki learning experience in the cardiorespiratory module. The transition to the underpinning constructivist pedagogy of the wiki may have been easier for these students if they had had the opportunity to access e-learning experiences which represented the transition from instructivist to constructivist pedagogy earlier in the course.

The use of constructivist learning theory in the cardiorespiratory module emphasised meaning making or the active process of building knowledge rather than memorising and understanding knowledge with which the students were accustomed (Somekh et Lewin, 2005) and would appear more time consuming. Although the number of face to face hours had been reduced in the new cardiorespiratory module to allow students time to carry out their wiki learning tasks, the

students still found the wikis time consuming. This manifested itself in different ways in the wiki learning task. The asynchronous nature of the task was highlighted as was the amount of time students spent contributing to the wikis. These issues have been reported before in a large scale research project of undergraduate experience of blended learning in the UK (Sharpe et al, 2006b). The students reported spending lots of time searching for suitable information to support their treatments although they agreed that this had helped their finding and using information skills for other modules especially their dissertations.

The students reported that the extra time that they were spending doing the wiki tasks was taking time away from learning knowledge and skills both in the cardiorespiratory module and other modules on the course. This means that the students had not understood how participating in the wiki could be a useful learning experience. Cramphorn (2004) has suggested that the constructivist nature of e-learning can be a barrier to student learning in its own right, especially in the early stages of the learning process and where students are more accustomed to traditional, tutor led learning experiences. This means that for future students the benefits of using this kind of learning must be clearly laid out for students as they embark on the module as well as explaining how their experience will differ so that they are prepared for the change to constructivist learning.

6.2.3. Aim three: To explore the use of sociocultural theory as a framework to consider the contribution a case based wiki may make to the development of clinical reasoning skills in pre-registration physiotherapy students.

This research used Vygotsky's sociocultural theory as a framework to analyse the influence of a case- based wiki on physiotherapy students' clinical reasoning development. Several methodological approaches could have been taken to this piece of research. Other research about clinical reasoning reviewed in this thesis has used predominantly grounded theory and phenomenological approaches. Clinical reasoning is a complex skill which encompasses the professional attributes of autonomy, responsibility and accountability and being able to make decisions in conditions of uncertainty (Higgs and Jones, 2008). Learning to reason has been described as a journey of professional socialisation (Richardson, 1999) and this describes a process through which the norms and values of a profession are socially constructed and internalised through active participation in learning to develop a professional identity (Ajjawi and Higgs, 2008). The journey of professional socialisation goes on over a long period of time, starting before the students begin their university course, picking up pace during the course and continuing after graduation. For me one of the main benefits of using Vygotsky's sociocultural

theory as a framework to analyse the findings of this research is that it introduced a lens through which to analyse and interpret findings as the students' clinical reasoning developed, rather than collecting data at a fixed point towards the end of the students' physiotherapy education. This idea is captured by reiterating Vygotsky's (1978) statement:-

'To study something historically means to study it in the process of change...' (p65),

This research showed that the development of clinical reasoning is not a linear process as suggested by Hendrick et al (2009) and that not all students will have reached the same understanding about clinical reasoning at the same time point in the course. This was evident in the wiki text analysis, where some students seemed to be clearer about the concept of clinical reasoning and were playing a major role in scaffolding the other students' learning whilst most other students found clinical reasoning to be a 'fuzzy concept' at the start of their clinical learning experience.

Vygotsky's concept of internalisation (Vygotsky, 1978) helped to show where students had appropriated the concept of clinical reasoning and were able to give examples of how they could demonstrate their learning about clinical reasoning by showing how their thoughts had transformed from social processes of developing joint understanding about clinical reasoning, in the wiki or in their clinical education experience, to the making of meaning and understanding about clinical reasoning, which they could utilise in their physiotherapy practice (John-Steiner and Mahn, 1996). This was not a simple linear transformation for the students to internalise the concept of clinical reasoning but a dialectical process whereby the students were using social processes to construct their understanding about clinical reasoning, for example by participating in the wiki, but also having their understanding about clinical reasoning constructed by the social processes in which they were participating, for example being part of a multidisciplinary team in clinical practice (Vygotsky, 1978).

Vygotsky's concept of dialectics (Vygotsky, 1978) also provided a way to understand the different learning experiences of the students from the taught course, the wiki and the clinical learning experience. This was not just to examine how the learning experiences differed in their contribution to learning about clinical reasoning but also to look at a synthesis of the different learning experiences to show how the students in this study developed their clinical reasoning. Ludvigsen et al (2011) support this notion by arguing that learning is situated but still takes place across different learning contexts or sites. In relation to our students, this would be the university and clinical environment and the different learning experiences, taught course, wiki and clinical

placement. Studying how the wiki influenced the development of the students' clinical reasoning, using sociocultural theory, allowed an understanding to develop of how previous knowledge and experiences about clinical reasoning from the taught course or wiki, became relevant and were used in new contexts (Ludvigsen et al, 2011). As the data in this study was collected as the students' clinical reasoning developed at three time points, the iterative nature of data collection allowed data from previous analysis to feed into subsequent data collection and so explain how understanding about clinical reasoning was used in new contexts (Ludvigsen et al, 2011). Not only did the iterative nature of data collection lead to new and deeper understanding about clinical reasoning development but it also gave the opportunity to check participants' views from previous analyses, thus demonstrating some rigour to the study.

Vygotsky's concept of semiotic mediation (Vygotsky, 1986), which he believed was the key to the connection between individual functioning or understanding and social, cultural and historical settings, has provided a way of understanding how the wiki influenced the students' clinical reasoning development in this research. Using this construct in the data analysis demonstrated how the wiki was scaffolding the students' learning in different ways in the wiki text analysis. The coding that emerged in this stage of the data analysis mapped onto the ways in which the students explained that they developed their clinical reasoning in clinical practice and showed how the wiki learning experience reflected that of the clinical learning experience by allowing the students to discuss and do clinical reasoning and to develop key skills such as critical thinking skills. Using Vygotsky's concept of semiotic mediation has not only shown the value of the wiki in developing the students' clinical reasoning but also highlighted the importance of how communication with students about the way in which a learning task will help develop certain skills may be fundamental to the learning experience.

Having considered different aspects of Vygotsky's sociocultural theory in relation to this research, it would seem a particularly useful framework to apply to this piece of research. Learning clinical reasoning, whether it takes place in the taught part of the course or on clinical placement is a social process initially because it is mediated by communication within a professional, cultural context. For the student to be able to clinically reason effectively, they have to actively participate in learning to transform these social processes to their individual understanding.

6.3. Limitations

This piece of research is a small detailed piece of work. This is not necessarily a limitation but the nature of the participants in this study may limit the transferability of these findings. Braun and Clarke (2013) suggest that readers of a piece of research should be able to make a judgement about transferability to other participants and contexts based upon a rich, detailed description of specific features of a study such as context, participants and setting. The participants in this study were recruited as volunteers who had had the experience of participating in the wiki learning experience. The participants were all female; half of them were mature students who had had other work or university course experiences before starting the physiotherapy course and three of them graduated with a first class degree, the rest with a 2:1 degree. These participants may not represent a typical cohort of students on a traditional pre-registration physiotherapy course and this should be considered when evaluating the transferability of these findings.

The students in this research all actively participated in the wiki learning experience. It is not clear whether those students who do not participate in the wiki develop their clinical reasoning capability in the same way or to the same degree by the end of their placements as the students who took part in this research. Further research is therefore needed to focus attention on non-participants to find out how they developed their clinical reasoning capability and why they did not participate in the wiki learning experience.

This research has highlighted how a case based wiki contributed to the students' clinical reasoning development and so considered the whole learning experience, that is, the change to case based learning as well as the use of the wiki. The findings of this research will not be generalisable to all TEL situations which are designed to develop clinical reasoning. The way in which the wiki is introduced, and the affordances of the TEL which arise from this, should be considered when applying these results to other situations.

6.4. Reflexivity statement

Reflexivity has been defined as:-

'...thoughtful, self-aware analysis of the intersubjective dynamics between researcher and the researched.' (Finlay and Gough, 2003, p ix)

Reflexivity can help to explain and clarify how the researcher's experiences, beliefs and personal history can influence the research process (Johnson and Waterfield, 2004) and should be seen as a resource rather than a source of bias or error (Sim and Wright, 2000). Explicit reflexivity can help

to make research more meaningful and enhance the credibility of research findings (Mays and Pope, 2000). Gough (2003) stated that reflexivity which only focuses on the researcher may make the analysis seem limited and goes on to suggest that relevant institutional and cultural contexts should also be considered in reflexive practices. I have already positioned myself in and explained some of the context of this research in earlier chapters of the thesis. This section will consider how my position as the researcher and the context of and way in which the research was carried out may have influenced the findings and my development as a researcher.

This research idea and question came from my practice as a lecturer in physiotherapy. As the module leader for the cardiorespiratory module, I suggested changing the module to one which used TEL to try and enhance the students' clinical reasoning. I wanted the module to be successful and I wanted the students to enjoy their learning experience. I therefore had a vested interest in the outcome of the learning experience which could have manifested as bias in the research process. If the findings from the analysis of the wiki texts are taken as a standalone piece of research, implementing the wiki to help the students develop clinical reasoning capacity could be seen as a positive outcome. This was why it was vital to include the students' voice in this research to consider how participating in a case based wiki contributed to their clinical reasoning development from their point of view and why the constructivist approach taken to this piece of research was so important. How the students constructed meaning formed the basis of their reality about clinical reasoning (Guba, 1990) and this is what I wanted to capture. This sentiment is captured very well in the following quote from 'To Kill a Mockingbird' (Lee, 1960) as Atticus Finch talks to Scout about a difficult day she has had at school:-

'You never really understand a person until you consider things from his point of view... until you climb into his skin and walk around in it.' (p35)

I wanted to really consider and understand the student's point of view.

My position as a lecturer meant that I was in a position of power in relation to the participants in the study. In the interview process, the researcher is considered to be the primary instrument of data collection (Jongbloed, 2000), so the ethical considerations of the research had to be managed carefully. How this was managed in relation to the design of this research was discussed in the methods section of Chapter Four of this thesis, however my position of power in relation to the participants was an ongoing consideration during the data collection and afterwards as the data was analysed. Although I tried to reduce the power imbalance between myself and the participants by conducting the interviews in an interactive manner and by carrying out sequential interviews (Carpenter and Hamell, 2000), whilst carrying out the interviews, I sometimes

struggled not to 'preach' to the students about my bias in favour of the wiki. This is illustrated in the following excerpt from the follow-up interview with Sharon. Sharon had not seen the similarity between a clinical reasoning form she had been asked to use on placement and the structure of the wiki until she was asked about how the two compared:-

'Researcher: Can you see any links between that and the grid that you had for the wiki?

Sharon: Oh. <LAUGHS> Hadn't even thought of that. Yes, I suppose so, it was 1-2-3, wasn't it?

Researcher: Well, we had 4 because we had evidence as well but, um, that's another part of it

Sharon: Yes, there was problems, hadn't actually related the two. Um...' Sharon, interview two

As this interchange took place, I was willing Sharon to see how the wiki reflected practice and confirm my feelings about the usefulness of the wiki. On reading this excerpt again, I can see how using my position and my bias in favour of the wiki like this may have made her feel rather humiliated.

I tried to be clear in presenting the research to the students that my position as a researcher was separate to that of a lecturer and that I would not be involved in any future assessment or examination boards of the year group, from which the students who participated in the study were recruited. I made every attempt to try and take on the researcher role and thus minimise the power imbalance with the students by only recruiting volunteers into the research, who gave their consent freely (Forwell, 2000), carrying out interviews in an interactive manner (Carpenter and Hamell, 2000) and using focus groups as the initial method of data collection for the majority of students (Barbour and Schostak, 2005). Although I tried to assume the researcher role, the students in the study may have had difficulty accepting this change in my role. I may have unintentionally behaved in a manner towards the students which left them unconvinced that I had really adopted the role of researcher. This could for example have manifested itself in my unwittingly silencing a topic in the discussion in a focus group or interview by the way in which I acted (Braun and Clarke, 2013). I cannot be certain that this did not affect the research.

Kvale (1996) recognised that the contexts in which we exist affect our identities and experiences and that this '*perspectival subjectivity*' (p212) will affect the way in which we collect and analyse data. In qualitative research the context in which a piece of research is carried out and how this affects the research process and analysis should be fully explained so that readers of the research may take these into account to consider for example, transferability of the findings to their

situation. In this research, I have attempted to explain the context fully to allow the reader to draw conclusions.

I based my data analysis on Braun and Clarke's (2006) six stages of thematic analysis. The data analysis is another stage of the research which could be influenced by my wish to find a positive outcome for this piece of research. It was important to check and double check that the codes and themes that I had identified in the data worked in relation to the whole data set and that the extracts that I chose to illustrate the codes and themes confirmed the narrative of the research story, whilst also representing the constructed meaning of the participants.

My wish to find a positive outcome for this piece of research was also influenced by the necessity of finding an original contribution to the literature as required in Doctoral theses. Brabazon (2010) in an article entitled 'How not to write a PhD thesis' gave the following advice:-

'Assume something you are doing is new because you have not read enough to know that an academic wrote a book on it 20 years ago.'

My learning journey into the theory of clinical reasoning and especially technology enhanced learning has been steep. When I started this journey, I had not read very much at all about e-learning as it was called at the time. Although I believe that I have searched the literature carefully using relevant keywords and combinations for this thesis and taken the advice of experts in the field about the literature with which I should be engaging, I am still worried that there is something that I have missed that may affect my original contribution.

As I reflect on my learning from carrying out this thesis, I realise that my knowledge has increased dramatically in relation to not only clinical reasoning and technology enhanced learning but also qualitative research methodologies and their underpinning theoretical perspectives. All this new knowledge feeds into my role as a lecturer as I supervise students doing their research and is used in designing and implementing learning experiences for students. This new knowledge and the work carried out in this thesis opens up possibilities for developing myself as a researcher and for further publications, as well as enhancing the skills which I use in peer reviewing journal articles prior to publication.

Exploring the wiki learning experience from the students' point of view has reinforced a rather basic lesson for me as a teacher. It is clear from this research that although I explained to the students that they would be using a wiki in the cardiorespiratory module to help develop their clinical reasoning in this field, that they would be working in groups and how to use the

technology, I do not think that I ever explained to the students why we were asking them to use this way of learning, how it asks them to practice skills which they will use in clinical practice. This also applies to the concept of clinical reasoning and how it is embedded in the course. What it means and why students need to know about it needs to be overt not just in the module in question in this thesis but in the rest of the course too.

I also understand now how carrying out research like this is like a continuous weight upon your shoulders that never goes away and how it requires enough time and lack of distraction to focus intensely upon the process. This has been extremely challenging for me at times. My challenges have given me increased empathy and patience with my students who seem to be taking forever to write a section of their dissertation or get on with their data collection.

As a middle-aged women with a full time job as a lecturer, a wife and a mother, I have several roles. I wanted to study for a Doctorate for professional reasons and to consolidate my understanding of an area in my professional life. Pearson et al (2004) explain how the profile of Doctoral candidates has changed from those who are young, full time and being prepared for work to those who reflect my situation much more closely and how a body of literature is starting to emerge about doctoral study.

My Doctoral journey, in line with many other students, has taken a long time and been punctuated by periods of increased personal stress, during which it became extremely difficult to focus on my thesis. The challenges which I have faced are not unique and the doctoral experience has been described as an excessively painful rite of passage that leaves middle-aged women feeling isolated and alone as they emerge from their studies, (Heinrich et al, 1997). Heinrich (1995) also describes how it can take from six months to several years after graduation to recover from invalidating experiences suffered by participants during Doctoral programmes. These are very dark pictures of the Doctoral experience and although other authors acknowledge the benefits and positive aspects of Doctoral study, (Bates and Goff, 2012), discussion with colleagues who are undergoing or have undergone similar experiences show that all of them have had some very challenging times.

My other concern is how my pre-occupation with my studies may have affected my relationships with my family and friends. This was brought home to me very clearly when I attended my son's school for a parents evening and found the prayer illustrated in figure 6.1 amongst his work.

Friday 19th July my prayer

Dear God,

Thank you for all the food we eat and my friends and family.

I ask you to help my mother get her Doctorate before 2015.

please help me to get my 100 ^{merits} ~~marks~~

Amen

✓ I'm sure you will manage that.
A lovely prayer giving thanks and asking for help ☺

Figure 6.1 My son's prayer

My attention has been continually divided in the last six months as I have tried to finish writing this thesis and this has probably affected how well I have carried out my other roles too. When I have taken time out to do something with my family, it has taken a while to regain my focus and so this has resulted in me isolating myself further to get my thesis finished. I am writing this before I have submitted this thesis and had my viva so there is still part of the Doctoral journey to finish and there may be several outcomes for this process. However, now I want to move on and give the people who have supported me my time and undivided attention, to use the skills and learning I have gained in my professional role as well as carry out the research to try and answer the questions arising from this thesis, and further develop my understanding in the field.

7. Chapter Seven: Conclusions

This research explored the research question:-

How does the experience of participating in a case based wiki prior to clinical placement contribute to the development of professional practice skill of clinical reasoning from the pre-registration physiotherapy students' perspective?

This research shows how the introduction of a constructivist TEL module and the resulting shift in underlying pedagogy influences the learning of physiotherapy undergraduate students, who are accustomed to a traditional course underpinned by behaviourist pedagogy. The findings of this research not only show how a case based wiki contributed to the development of clinical reasoning skills in these students but also highlights how important it is to prepare and support students for such a change in learning approach.

The findings of the research show that the case based wiki influenced the students' clinical reasoning development in different ways. For the students in this research the case based wiki brought attention to clinical reasoning in their course, focussed their clinical reasoning on the patient, allowed them to practise clinical reasoning and gave structure to their clinical reasoning. From the students' point of view, the way in which the case based wiki was used in their learning experience, made them develop their skills for finding and using information and critical thinking skills. However, the way in which students were asked to use evidence to support their treatments in the wiki, caused confusion between the concepts of clinical reasoning and evidence based practice as the students started their clinical learning experience. These are all original findings from this research.

This research showed how clinical reasoning was embedded in the taught part of this pre-registration, traditional physiotherapy course, thus largely leaving the students to learn about clinical reasoning themselves. This supports the findings of Christensen et al (2007). The students' understanding about the concept of clinical reasoning was 'fuzzy' as they started their clinical experience even though they had been doing clinical reasoning in the wiki.

This research highlighted the ways in which these students developed their clinical reasoning capability as they progressed through their clinical placements. In the early stages of their clinical learning experience, this was by taking on a burden of responsibility for the patient, which transformed into working with the patient as their clinical learning experience progressed. This is

an original finding and is in contrast to other research which has considered how students conceive and understand clinical reasoning (Hendrick et al, 2009; Cruz et al, 2012).

Another way in which students in this research developed their clinical reasoning as they progressed through their clinical learning experience was by communicating with others, who included their supervisor, the patient, other physiotherapists or members of the multidisciplinary team, about their clinical reasoning. Ways of communicating included articulating clinical reasoning in discussions about ways of treating patients, justifying their treatment to others or writing patient notes and reports. This is an original finding in relation to how physiotherapy students develop their clinical reasoning from their perspective, but has been reported before by Ajjawi and Higgs (2007; 2008) who studied how experienced physiotherapists developed their clinical reasoning.

Other ways in which students in this research developed their clinical reasoning whilst on clinical placement were by repeated practise of clinical reasoning in acute care placements, doing clinical placements in clinical areas about which they had learnt only a small amount in their taught course and by reflecting on their clinical reasoning. These ways of developing clinical reasoning are all original findings from this research in relation to students but also reflect the research of Ajjawi and Higgs (2007; 2008). The students in this research developed their clinical reasoning in one other way, which is an original finding by using standard assessment forms or other tools such as forms designed to help develop clinical reasoning.

The findings of this research would suggest that a case based wiki is an excellent tool to help develop students clinical reasoning capability, however the findings of this research also demonstrate the difficulties which the students in this research had adapting to a TEL, constructivist learning environment. Although the research findings show that students were engaging in meaningful interaction by clinical reasoning in the wiki, they were not clear about the concept of clinical reasoning as they were doing this. The concept of clinical reasoning and developing students' understanding of this concept should be one of the foundations upon which physiotherapy pre-registration courses are built.

The findings of this research also demonstrate that scaffolding of the students' learning about clinical reasoning was taking place but the students were not clear that this is how their learning was being supported. When the underlying pedagogy shifts in a course, students should be prepared and supported for changes in their learning experience and be helped to develop an understanding of the reasons for making such changes. The move to a constructivist learning

environment for the students in this research, who were used to a behaviourist pedagogy manifested as difficulties with group working, managing time and a feeling that the TEL in the module was taking time away from learning knowledge in relation to that module and others. These findings in relation to the difficulties that students have with shifting underlying pedagogies are not new (Cramphorn, 2004; Sharpe et al, 2006b), but support the existing research.

This research has shown the effectiveness of using Vygotsky's sociocultural theory as a framework to consider how a case based wiki influenced the students' clinical reasoning development from their point of view. Vygotsky's concepts of semiotic mediation, dialectics and internalisation (Vygotsky, 1978), provided a structure to study the students' clinical reasoning as it developed and across different settings, up to the point where students were able to demonstrate that they were able to clinically reason in an autonomous, accountable and responsible manner in underlying conditions of uncertainty and clinical reasoning had become 'simple'.

7.1. Recommendations

The findings from this research show that whilst using a case based wiki to develop clinical reasoning skills is to be recommended and had some positive outcomes for the students in this research, lessons can be learnt about the way in which clinical reasoning capability is developed in physiotherapy students in both traditional courses and those which introduce constructivist TEL to their students.

As the basis of professional practice, clinical reasoning may be embedded within physiotherapy courses but this should be in an overt manner. Not only should physiotherapy students be introduced to the concept of clinical reasoning from the start of their course, but they should also understand how critical thinking skills link with the development of clinical reasoning. The development of clinical reasoning should be one of the key foundations upon which pre-registration physiotherapy education is built.

This research has shown that using a case based wiki can have a positive influence on how students perceive their clinical reasoning develops. However the positive influence of the wiki may be increased further if the students understand how learning takes place and is supported within a TEL constructivist learning environment and how the features of this learning have a congruence with the kind of learning which takes place in the clinical learning experience. This supports the findings of Christensen (2007) who suggested that students who could adapt to different ways of learning became capable clinical reasoners. Exposing students to varied learning

experiences within the taught course and helping students understand how they learn from them should be encouraged.

The findings of this research show that students need to participate in the wiki actively to gain the most benefit in developing their clinical reasoning capability. All of the students in this research participated actively in the wikis. Those students who do not actively participate should be encouraged to do so, to reflect the active participation required for professional socialisation and becoming a physiotherapist (Ajjawi and Higgs, 2008).

The findings from this research show that students were able to identify ways in which their clinical reasoning developed whilst in practice. These ways of developing clinical reasoning should be made explicit to students and clinical supervisors so that the students have varied strategies for developing their clinical reasoning in practice and the clinical supervisors are able to support the students with these.

7.2. Further research

The findings of this research suggest raise other research questions which could help to further develop understanding in this area. The first of these is to repeat this research in a situation where the concept of clinical reasoning is clear to the students and a foundation of the physiotherapy course. Would the wiki prove to be as useful for developing clinical reasoning capability? Similarly, the students were not clear how the wiki supported their learning about clinical reasoning in this research. If these links are made for the students, are they able to adapt to constructivist TEL environments more easily?

This research considers the introduction of a case based wiki to influence the development of clinical reasoning. It is not completely clear from this research if it was the wiki or switching to case based learning which provided the benefits in terms of clinical reasoning. As there is a pre-registration physiotherapy problem based learning course in the institution where this research was carried out, which also uses a case based wiki in the cardiorespiratory module, it would be interesting to explore how the wiki influences learning about clinical reasoning in the problem based learning course. Active participation in the wiki environment has been suggested as important by the students in this research to learn about clinical reasoning. From the times that this module has now run, it is evident that there seems to be a pattern linking no or poor participation in the wiki with poor assessment results and poor performance on placement. These links could be explored further to understand why students do not participate in the wiki and whether it influences their further development as a physiotherapist.

Nearly half of the students who participated in this research went on to achieve first class degrees. All the students who took part in the interviews and focus groups in this research participated actively in the wikis and some played a major role in scaffolding others' learning. It would be interesting to explore whether there is any link between participation in the wiki achievement and progress of students in their careers.

This research has highlighted how a case based wiki contributed to the students' clinical reasoning development but used a small group of participants and considered the whole learning experience. This included the change to case based learning as well as the introduction of the wiki. The findings of this research will not be generalisable to all TEL situations which are designed to develop clinical reasoning. The way in which the wiki is introduced and the affordances of the TEL that arise from this as well as the context and participants, should be considered when applying these results to other situations.

This research has identified some original findings and given support to the work of others. The complexity of introducing constructivist TEL experiences into traditional courses and the many different ways of doing this has been highlighted. The findings of this research support the notion that TEL can be used to develop clinical reasoning capability and has the appropriate affordances to meet the learning outcomes for this. However, how the technology changes a learning experience, for example the underlying shift in pedagogy and the reasons for making these changes, for example so that the learning experience has a congruence with other learning the students will encounter in their clinical reasoning development, must be made explicit.

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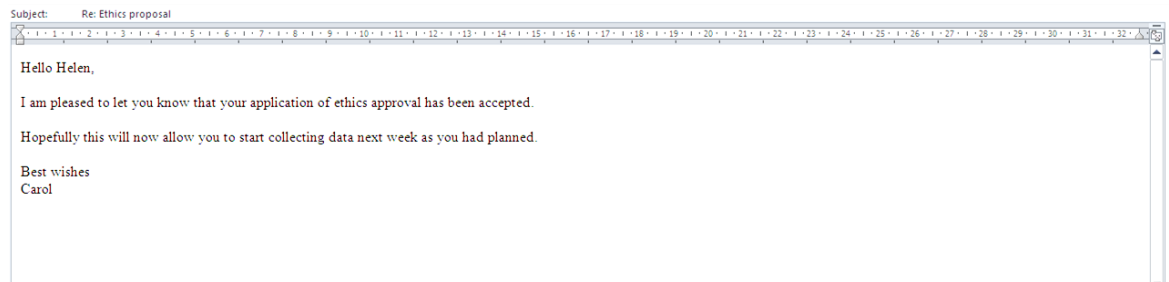
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Appendix A: Ethics approval



Appendix B: Consent form for use of wiki texts in this research

**School of Education
Doctorate in Education**

Consent Form

Title of Project: **An investigation into how the experience of participating in a case based wiki prior to clinical placement contributes to the development of clinical reasoning from the pre-registration physiotherapy students' perspective.**

Name of Researcher:

Please consider the following before signing this form.

Your signature confirms and gives your consent that you are happy to take part in this study and that you accept the following:

I agree to allow the wiki which my group developed during the module (number and name of the TEL cardiorespiratory module) to be analysed for the development of clinical reasoning skills and for the analysis to be used as a basis for discussion in focus groups and interviews as part of the 'An investigation into how the experience of participating in a case based wiki prior to clinical placement contributes to the development of clinical reasoning from the pre-registration physiotherapy students' perspective' project. My participation is entirely voluntary.

.....Name of Participant, Date, Signature

Appendix C: Participant information sheet for focus groups and interviews

School of Education

Doctorate in Education

Participant Information Sheet

1 Study title: An investigation into how the experience of participating in a case based wiki prior to clinical placement contributes to the development of clinical reasoning from the pre-registration physiotherapy students' perspective.

2 Invitation paragraph

I would like to invite you to take part in this research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask me if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

3 What is the purpose of the study?

This study aims to try and gain a better understanding about whether the use of a case based wiki prior to clinical placement may help develop clinical reasoning in pre-registration physiotherapy students from their perspective.

4 Why have I been invited?

You have been chosen because you are an undergraduate physiotherapy student who has participated in module (number and name of the TEL cardiorespiratory module) and have experience of the e-learning approach used in the module.

5 Do I have to take part?

Taking part in the research study is entirely voluntary. It is up to you to decide whether to take part or not. The study will be described to you and any questions will be answered. You will then be asked to sign a consent form to show you have agreed to take part. You are free to withdraw at any time, without giving a reason and with no consequences.

6 What will happen to me if I take part?

You will be asked to take part in one focus group with approximately 6 other students and one individual follow up interview, which may be face to face, via Skype or the telephone to discuss your experience of developing clinical reasoning skills and whether your participation in the wiki contributed to this. The focus group and interview will last approximately one hour and will be recorded. The recordings will be transcribed. The focus group and interview will remain confidential and no participants will be identified in the transcripts. The recordings will be kept in a locked filing cabinet in the researcher's office. The transcripts will be stored on a password protected computer. This information will be kept until it has been analysed and written up into a report. It will be destroyed upon completion of the researcher's Doctorate. No participants will be identified in any consequent publication. The researcher will take no further part in assessment of the students who participate in the study whilst they are a student on the BSc (Hons) Physiotherapy course.

7 What are the possible disadvantages and risks of taking part?

There are really no disadvantages to taking part except the minimal possibility that some of the topics discussed during the interview may cause distress (although every effort has been made to minimise the chances of this happening). If this should happen the focus group or interview will be stopped and you will be provided with the contact details of a colleague who is available to talk to you.

8 What are the possible benefits of taking part?

Although you may not benefit directly from taking part in this study the information we get will help us understand how clinical reasoning skills are developed in this group of pre-registration physiotherapy students and whether the wiki has played a part in this. This information will inform future educational practice in relation to this. You may also benefit from reflecting on and discussing the development of your clinical reasoning skills.

9 What if there is a problem?

Any complaint about the way you have been dealt with during the study or any possible harm you might have suffered can be addressed by contacting my supervisors. For contact details see the bottom of the information sheet

10 Will my taking part in the study be kept confidential?

The focus group and interviews will remain confidential and no participants will be identified in the transcript. The tape will be kept in a locked filing cabinet in the researcher's office. The transcript will be stored on a password protected computer. The data will only be seen by the researcher and her supervisor. Once the data has been analysed the tape and transcript will be destroyed. No participants will be identified in any consequent publication.

11 What will happen if I don't want to carry on with the study?

If you don't want to carry on with this study, you may withdraw at anytime and without giving a reason. You will be asked whether data collected up to the point of withdrawal may be used in the study. You may choose to decline with no consequences and your data will be destroyed.

12 What will happen to the results of the research study?

The results of this study will be used in an assignment for a Doctorate in Education. They may also be published at a relevant conference or within a relevant journal. No participants will be identified in any consequent publication.

13 Who has reviewed the study?

This study has been reviewed and given Tier 1 approval by the School Research Ethics and Governance Panel, School of Education, (Institution).

14 Contacts for further information

Researcher and supervisors details:

Thank you for considering taking part in this study 15.05.12

Appendix D: Consent form for focus groups and interviews

School of Education

Doctorate in Education

Participant Consent Form

Title of Project: **An investigation into how the experience of participating in a case based wiki prior to clinical placement contributes to the development of clinical reasoning from the pre-registration physiotherapy students' perspective.**

Name of Researcher:

Please consider the following points before signing this form.

Your signature confirms that you are happy to take part in this study and that you accept the following:

1. I agree to take part in 'An investigation into how the experience of participating in a case based wiki prior to clinical placement contributes to the development of clinical reasoning from the pre-registration physiotherapy students' perspective' project. My participation is entirely voluntary.
2. I confirm that I have read and understand the information sheet dated 15.05.12 for the above study and the researcher has explained to my satisfaction the purpose, principles and procedures of the study and the possible risks involved. I have had the opportunity to consider the information and ask questions, which have been answered to my satisfaction.
3. I understand that I will be asked to take part in a focus group and follow up interview where the development of clinical reasoning skills will be discussed and whether the wiki in module PT219 played any part in this.
4. I agree to the information given to be analysed and to inform future practices.
5. I understand what my participation involves.
6. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.
7. I am aware that all interview data will be stored in secure, locked storage within the University. No data will be stored on any hard drives or any other devices which can be remotely accessed. The data will be destroyed within a year of the completion of the research project
8. I understand that any confidential information will be seen only by the researchers and will not be revealed to anyone else.

Confirmation and consent

I confirm that I have freely agreed to participate in the 'An investigation into how the experience of participating in a case based wiki prior to clinical placement contributes to the development of clinical reasoning from the pre-registration physiotherapy students'

perspective' project. I have received information about the project and what the participation involves and I agree to the findings being used as described above.

.....Name of Participant, Date, Signature

.....Name of Researcher, Date, Signature