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THE JOURNEY TOWARDS UNDERSTANDING

Exploring the interplay between teaching
and learning

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ABSTRACT

This thesis explores students' journey towards understanding throughout a nine-week course in their second year of an undergraduate medical programme. Although the investigation was undertaken in the context of a medical curriculum, the overall aim, to investigate the development of students' experiences of learning and understanding, relates to issues in higher education in general. An exploratory, qualitative research approach was adopted, and data were collected through student interviews and written accounts from medical students taking a compulsory course in pathology. Of all the teaching and learning activities that this course offered the students, three in particular were selected for in-depth analysis with a focus on students' experiences of learning and understanding in relation to these activities: a case seminar (Study I), formative assessments (Study II) and autopsies (Study III). Study IV broadened the scope of the previous studies and investigated the students' experiences throughout the course.

Previous research has showed that students are sensitive to their learning environment and tend to adopt either a surface, deep or strategic approach to learning. The findings presented in this thesis suggest a more complex picture of how medical students approach their learning and develop understanding in the course of pathology, and suggest potential pathways students might take towards developing a deep understanding. Initially, students seemed to focus on understanding the basic terminology and getting a brief overview of the course content. Subsequently, the students focused on how to manage the vast amount of information they were supposed to learn. Some students developed a form of catalogue-like understanding of the content, while others developed a more integrated understanding. Furthermore, the design of the course as a whole with its varying teaching and learning activities strongly influenced the ways in which students set about understanding the course content. Activities that explicitly related theoretical knowledge to real life examples, focused on problem-solving and application, and allowed time for reflection and discussion were activities that seemed to facilitate the development of a deeper understanding. Collaborative learning in small groups was also important for students' learning. When students perceived the activities as being meaningful, relevant and interesting, they seemed more likely to engage in them.

This thesis offers a fine-grained analysis of medical students' approaches to learning within a particular course, suggesting potential pathways to achieving an academic understanding of course content within a medical curriculum. This research also points up important aspects of the complex relationship between teaching and learning in higher education that have more general implications for the design of courses and individual teaching and learning activities..

LIST OF PUBLICATIONS

I. **Weurlander, M,** Masiello, I., Söderberg, M. & Wernerson, A. (2009) Meaningful learning: students' perceptions of a new form of case seminar in pathology. *Medical Teacher,* 31 (6):e248-e253.

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CONTENTS

LIST OF ABBREVIATIONS

ILO	Intended learning outcomes
OBE	Outcomes-based education
PBL	Problem-based learning
TLA	Teaching and learning activities

1 INTRODUCTION

Human learning is a complex and multifaceted endeavour which continues throughout a person's lifetime. We learn to walk, talk and interact with others. At school we learn to read, write and calculate. We learn concepts and theories which help us to understand, and enable us to act in the world in new ways. Learning involves the acquisition and development of diverse qualities such as knowledge, skills, beliefs and attitudes. Without the ability to learn, we could not survive. Learning takes place in informal situations such as when children play or when adults learn in their workplace. It also takes place in formal educational settings, in primary, secondary or higher education. This thesis seeks to explore medical students' experiences of learning and understanding in the context of a compulsory undergraduate course. Learning can be described and viewed in a variety of ways. In this thesis, I use the metaphor of a journey to capture the learning endeavour. Shuell wrote:

"Imagine yourself about to embark on a long journey, a journey that involves learning a complex body of knowledge with which you currently are unfamiliar. At first, the new terrain appears strange, although certain similarities with familiar territory can be identified."
(Shuell, 1990:532)

Metaphors are powerful, and can form a bridge between everyday thinking and scientific concepts (Sfard, 1998). Using the journey as a metaphor encapsulates the concept of learning both as a process which occurs over time, and as a personal experience of gaining new insights. Learning is about entering new, previously unknown fields of knowledge, and it involves becoming more able and knowledgeable as one explores this new terrain.

The metaphor of a journey can also be used to represent my own progress from a curious student studying the natural sciences, and then a young doctoral student learning about the structure and function of cells, to an engaged science teacher trying to help secondary school pupils learn biology and chemistry. After a while, I began to wonder about my pupils' learning, and whether the design of my teaching made a difference. I left the science classroom and entered the fascinating world of educational research. This journey took me from one research tradition to another, with a completely different set of assumptions about how research is best conducted. My journey from student to teacher, and now researcher, has been long and fascinating. The question I return to again and again is whether or not it matters how we teach, and there is general acceptance that it does. The details of why, however, are a little more complicated, and the present thesis is an attempt to shed light on this multifaceted issue.

The thesis focuses on learning and understanding during an undergraduate course in a medical programme. Although the context is medical education, the research questions and the patterns which emerged are relevant beyond this field. Students in higher education in Sweden are generally enrolled in undergraduate or graduate programmes which often consist of a series of obligatory courses. The subject of the present research is a mandatory course in pathology, an essential part of medical education. Each new

course students take can be described as entering a new terrain of subject-specific knowledge presented in unknown terminology. They are embarking on a journey towards understanding, and making the unfamiliar into the familiar. Students are not left to themselves, as each course offers a series of teaching and learning activities, designed to equip them with the necessary tools and knowledge for their journey. But what do their journeys entail?

We chose a pathology course as the context for this research project, a course taught at the end of the second year in the medical curriculum. Pathology is the study of diseases, and it was chosen because it belongs to the basic sciences, but also provides a bridge to the clinical sciences of the medical curriculum. This particular course included a variety of teaching and learning activities, which made it interesting in terms of exploring students' learning and understanding. Furthermore, students participated in autopsies as part of the course, and the strong emotions evoked by these sessions provided an interesting dimension to the study.

OUTLINE OF THE THESIS

The focus of the present thesis is learning and understanding in the context of an authentic course. Learning and understanding are complex phenomena and involve many interrelated aspects. The present thesis draws mainly on research on learning and understanding in higher education, which is, in itself, a broad research field. However, the background also includes overviews of research on medical education and how teaching facilitates understanding, as these fields are relevant to this research project. The project covers a broad theoretical sphere of factors influencing learning and understanding. This extensive coverage was considered necessary in order to highlight relevant aspects of the research. The many aspects introduced in the background reflect the complexity of the phenomena of learning and understanding. The following chapter provides a theoretical background, where the central concepts of learning and understanding are described and discussed. Teaching and designing for understanding are described in Chapter 3. Chapters 2 and 3 also provide an overview of previous research on student learning in higher and medical education, as well as teaching to facilitate understanding.

Chapter 4 presents the aims of the present research, and Chapter 5 describes the theoretical stance underpinning the research methodology used in the design, data gathering and analysis of the different studies. The pathology course, as it was designed at the time of data collection, is described in detail in Chapter 5, to help the reader to understand the context of the research presented in this thesis.

The main findings of the four studies are described in Chapter 6. Preliminary findings from an additional analysis, not included in the four studies, are also presented here. The findings are discussed in Chapter 7, and are examined in relation to medical education, to subject-specific issues concerning learning and understanding pathology, and to more general points and reflections regarding learning and understanding. Finally, a number of implications for practice are introduced which could inspire teachers and educators in developing their own teaching.

2 LEARNING AND UNDERSTANDING

This chapter will present the concepts of learning and understanding, which are central to this research project. Since human learning is such a complex phenomenon, no single theory explains all its aspects completely. Learning theories typically focus on either the individual learner, or the social and cultural context in which learning takes place.

LEARNING

Contemporary learning theories describe learning as an active process, where the learner constructs knowledge and understanding of phenomena such as concepts and subject matter (Bransford, Brown & Cocking, 2000; Leach & Scott, 2003; Schunk, 2004; Perkins, 1999). According to this constructivist view, knowledge is not something objective which can be transmitted from teacher to student. Instead, knowledge is subjective, and is considered to be constructed in dynamic interaction with the physical and social learning environment (Schunk, 2004). Learning involves both individual and sociocultural aspects, but many theorists focus on only one of these. Constructivist theories of learning stem from the work of Jean Piaget, Lev Vygotsky and Jerome Bruner, among others (cf. Fosnot, 1996). Piaget believed learning to be a dynamic process consisting of two different, but complementary, processes: assimilation and accommodation. Assimilation is an additive process where new experiences are organised into our cognitive structures and understandings, and it is considered a more basic process than accommodation. Sometimes, new experiences contradict our present understanding and cannot fit into pre-existing structures. This means that we accommodate, or change the cognitive structure through reflection and integration, and transform our understanding. Although Piaget (cf. Fosnot, 1996) was interested in learners as individuals, he acknowledged that they interact with the situation and the context. Vygotsky, who also investigated concept development, was more interested in the interaction between the individual and society, and focused his work on the effect of social interaction, language and culture on learning (Vygotsky, 1978). Piaget and Vygotsky have both had a tremendous influence on worldwide education in terms of theories of learning and educational practice.

The work of Piaget and Vygotsky gave rise to two main strands of learning theory: individual and sociocultural views of learning (Leach & Scott, 2003). Individual views focus on how the individual learner constructs knowledge and meaning in interaction with the environment. Theories of conceptual change (cf. Vosniadou, 2008) and the development of expertise (Schmidt & Rikers, 2007) are examples of this strand of research, which focuses mainly on cognitive aspects of learning. The sociocultural view builds on the work of Vygotsky, and concentrates instead on learning as *originating in social interactions between individuals, or as individuals interact with cultural products that are made available to them in books or other sources*" (Leach & Scott, 2003:93). Academic disciplines involve specific scientific concepts and language which students need to understand. Learning, according to the sociocultural perspective, involves a process of internalising the scientific language, acquiring ways of thinking about the discipline and practising it (Leach & Scott, 2003). Some

researchers argue that it is possible to bring together individual and social views of learning (Billett, 1996), while others insist that the two views are fundamentally different in terms of both epistemology and ontology (Packer & Goicoechea, 2000). Sfard (1998) offers another way of describing theories of learning using two metaphors: the acquisition and the participation metaphor. The acquisition metaphor sees learning as the process of acquiring knowledge, and is regarded as something the learner possesses. The participation metaphor, on the other hand, involves the process of becoming a participant, where the learner becomes more and more involved in the activities, community or discourse. Both metaphors have advantages and weaknesses, and Sfard argues that we need both, as they offer different perspectives. The phenomenon of transfer, or the ability to learn something in one context and use the knowledge in others, can only be explained in terms of the acquisition metaphor. To understand the process of enculturation, where students develop and socialise into a profession, we need the participation metaphor. This thesis focuses on a form of learning based mainly on conceptual understanding, and the discussion therefore concentrates on the acquisition metaphor as the main metaphor of learning.

Learning from the students' perspective

The concept *meaningful learning* originates in work by Ausubel and his co-workers (1968), who made a distinction between meaningful and rote-learning. Meaningful learning involves making an effort to understand concepts or phenomena and relate them to prior knowledge, whereas rote learning entails memorising isolated information in a routine way. Since the 1970s, researchers have been exploring learning from the learner's perspective, which has led to new insights into how students learn. Marton et al., for example, found that students adopt two main approaches to learning: a surface approach or a deep approach (Marton & Säljö, 1976a, 1976b, 1997). The researchers conducted a series of experiments where students read texts and were then interviewed on what they had understood from the text and how they had approached the task. The researchers found that some students missed the main points in the text simply because they had not been looking for them. This phenomenographic research, originating in the work of Marton and his colleagues in Gothenburg, has contributed significantly to our understanding of student learning. People are considered to have different concepts of learning, ranging from simply taking in information to transforming information to develop a personal understanding (Säljö, 1979). These concepts are hierarchical, moving from limited to more advanced notions of learning. More recently, an even more advanced concept has been described, where learning is seen in terms of a person's development (Marton, Beaty & Dall' Alba, 1993). Whether students adopt a deep or surface approach in a specific situation is explained as a combination of the person's concept of learning and how she or he experiences the situation (Marton & Booth, 1997).

The research presented in this thesis explores the experience of learning from the student's perspective. As experience is a central concept in theories of learning, this will be discussed briefly. Experience may be viewed to embrace of the following dimensions: cognitive, emotive and physical (Jarvis, 2006). We experience the world through our senses, and become aware of our experiences not only through our thoughts, but also through sensations and feelings. In this thesis, experiences are

considered to be personal, and through them we learn, act in the world and develop as human beings. In education, phenomena in the external world are often mediated by explanations in books or by teachers, through pictures or illustrations, or presented in the form of theoretical ideas (Jarvis, 2006). Students have limited opportunities to experience them first hand, which may influence learning and make it difficult to understand these phenomena fully. To experience phenomena in the world around us, we need to experience things *as* something. In order to do this, we need to distinguish phenomena from other aspects of the surrounding world, yet still relate them to the specific context (Marton & Booth, 1997). At any given moment, some aspects are in the foreground of our awareness, while others remain in the background (Asplund, 1970; Marton & Booth, 1997). The experience of any learning situation involves two aspects: "what" and "how". Learning always involves learning *something*, for instance the structure of a cell, a mathematical algorithm or the regulation of blood glucose level, and this can be referred to as the *"what" aspect* or the *direct object* of learning. This aspect is the content the students are required to learn, and often involves mediated phenomena. The *"how" aspect* of learning refers to the learning act itself and to the approach students adopt in a given learning situation. This aspect involves the strategies students use to learn, their motives and intentions, and how they interpret the requirements of a situation or the task at hand. This thesis focuses on students' experiences of the "how" aspect of learning.

The approach students take has been found to be related to the learning outcome (Van Rossum & Schenk, 1984). Students who adopt a surface approach seem to view learning as memorising, and do not present answers of the same quality as students with a deep approach. It has also been found that students differ in the way they organise complex learning material. Some students organise the content in a holistic way, relating facts and parts to the whole, while others merely order the parts in an atomistic way, without relating to the whole (Svensson, 1997). Students' intentions in terms of their studies have also been found to have a major influence on their learning (Entwistle, 2009; Entwistle & Peterson, 2004). A surface approach has been associated with an intention to memorise as much knowledge as possible in order to meet the assessment requirements. In this case, the strategies students use seem to focus on rote learning, which often results in fragmented knowledge and lacks any deeper understanding. In contrast, students who approach their learning with the intention of understanding wish to learn for their own sake. They look for the underlying meaning in the task or text, relate new knowledge to their existing knowledge and are also more likely to acquire a deep understanding. At first, researchers believed memorising to be associated with a surface approach and a reproduction-directed orientation. However, the relationship between memorising and understanding has been shown to be more complex, and students aiming for a deep understanding have also been found to use memorising as a strategy for learning (Entwistle & Entwistle, 2003; Kember, 1996; Marton, Wen & Wong, 2005).

UNDERSTANDING

As mentioned above, students' intention or aim in their studies is one of the factors which differentiates deep and surface approaches. A deep approach to learning is

associated with an intention to understand for oneself (Marton & Säljö, 1997). This raises the question of what it means to understand. The concept of understanding is elusive, and there are very few definitions of what it entails. Two views of understanding can be identified from the educational literature: understanding as a mental model (representational view), and understanding as an ability to act flexibly in novel situations (performance view). According to the first strand of literature, understanding is to see something *as* something, or to grasp the meaning of something. Understanding can also be described as discerning patterns (Gärdenfors, 2010). In order to understand, the learner has to make connections and relate new information to prior knowledge in a meaningful way (Ausubel et al., 1968). Rote learning, on the other hand, focuses on routine repetition and memorising, and often results in fragmented, isolated knowledge. Understanding therefore involves building a coherent whole, integrating the many pieces of new and old information (Burns, Clift & Duncan, 1991). This coherent whole may become a mental image, sometimes referred to as a "knowledge object" which can be "visualised" (Burns et al., 1991; Entwistle & Entwistle, 2003; Entwistle & Marton, 1994). Bruner (1977:7) argues that the most important aspect of learning is to understand the underlying principles in each subject, and that *"grasping the structure of a subject is understanding it in a way that permits many other things to be related to it meaningfully. To learn structure, in short, is to learn how things are related"*. This process of integrating new knowledge into richer and more complex mental structures has been found to occur in phases, as medical students learn more and more about diseases and their symptoms (Schmidt & Rikers, 2007). The knowledge becomes "encapsulated", and concepts and understanding of detailed mechanisms and their interrelations are packed into high-level, abstract concepts which can be used to explain the same phenomenon. Understanding can be achieved to different degrees, or levels, ranging from a low level or limited understanding, to a high level or deep understanding. Phenomenographic research has revealed qualitative differences in students' understanding of subject matter, i.e. what they have understood from reading a text or how they have understood central concepts in economics, physics or mathematics (Bowden & Marton, 1998; Marton, Hounsell & Entwistle, 1997). This research has revealed differences in students' understanding of these phenomena, ranging from advanced to more limited understanding. More recently, researchers have explored medical students' understanding of anatomy and the concept of flow in physiology (Fyrenius, Silén & Wirell, 2007; Wilhelmsson et al., 2010). Understanding is dependent on the context and on the richness of a person's knowledge of a phenomenon (Burns et al., 1991; Nickerson, 1985). Understanding can grow gradually, in an additive, bottom-up process, as more knowledge is acquired and more connections are made between pieces of knowledge (Vosniadou, 2008). However, understanding can sometimes be a sudden phenomenon, like an "aha" experience or insight (Auble, Franks & Soraci, 1979; Wills, Estow, Soraci & Garcia, 2006). "Aha" experiences always seem to be preceded by a lack of understanding, indicating that these sudden insights first require us to be aware that we do not understand something. Developing understanding can sometimes be difficult. Knowledge can be troublesome in a number of ways. It can be counter intuitive, for example, or learned by heart but not integrated into prior knowledge, which can hinder the development of a deep, personal understanding (Perkins, 1999).

Understanding, as described above, is viewed as a mental model or representation, as something a person possesses. It is a common concept in psychological research and in everyday language (Perkins, 1998). This view of understanding conforms to the acquisition metaphor of learning, and has been criticised for not acknowledging sufficiently the social and cultural context of learning (Sfard, 2002). In contrast to the representational view, the performance view of understanding sees it as the ability to think, explain, relate and use knowledge flexibly in new and different situations (Newton, 2000; Perkins, 1998). It focuses on what a person can *do* when he or she understands something. According to Sfard (2002), understanding is about experience, and she is opposed to a mental representation of the phenomenon. She argues that understanding does not have to precede the use of knowledge, and proposes that comprehension can develop hand-in-hand with the use of knowledge. Students with a limited understanding are able to mention and describe topics briefly, whereas students with a deeper understanding can explain the same topic and relate it to similar ones. Perkins, who shares this view of understanding, wrote: "*Understanding shows its face when people can think and act flexibly around what they know. In contrast, when a learner cannot go beyond rote and routine thought and action, this signals lack of understanding*" (Perkins, 1998:42).

Another important aspect includes the fact that students' understanding is personal, and influenced by their interpretation of the task and the context (Entwistle & Smith, 2002). Furthermore, understanding is always partial and provisional. As we learn more, our understanding and the ability to use our knowledge develops (Perkins, 1998). From an educational standpoint, the performance view of understanding is particularly interesting. When learners are engaged in activities which put their understanding to work, their level of understanding becomes visible to others, and it is possible to assess the extent to which students have understood a phenomenon. However, teachers need to assess the performance of their students in relation to a "target understanding", which is the level of knowledge and understanding students are required to reach at a certain stage in their education (Entwistle & Smith, 2002). Embracing the performance view of understanding has implications for the type of teaching and learning activities we design, which will be discussed in the next chapter.

Learning and understanding

As noted above, understanding can be conceptualised as having dimensions of both process and product. Understanding involves an active exploration of connections between pieces of information, and the interpretation of concepts and processes in using one's knowledge (Ausubel et al., 1968; Burns et al., 1991; Perkins, 1998). This is known as "the process". The result of this process is a set of coherent wholes, which are more or less rich in interconnections, and the ability to act flexibly with one's knowledge (Entwistle & Entwistle, 2003; Entwistle & Marton, 1994; Marton et al., 1997; Perkins, 1998). This is known as "the product". Learning can therefore also be described in terms of process and product (Ausubel et al., 1968), where understanding always involves learning, but not all learning involves understanding. In phenomenographic research, on the other hand, understanding is viewed as an outcome of learning. The different approaches to learning have implications for the learning process, whether they involve memorising routinely or making interconnections and

relating to prior knowledge and experiences (Marton & Booth, 1997; Marton et al., 1997). Learning is therefore seen as a process which can result in different qualitative levels of understanding. However, the process and product dimensions of learning are intertwined. There are no "end points" in learning. It is a journey, and there will always be more to learn. In this thesis, learning is viewed as an overarching concept which involves theoretical knowledge, practical skills and attitudes, and which includes both a process and a product dimension. Theoretical knowledge can be learned by heart and recalled, and procedures can be learned and performed routinely. Neither of these involves understanding. In this research project, however, understanding is considered to have two dimensions. On the one hand, it is an active process of meaningful learning, whereby concepts are related and connected to prior knowledge and experiences. On the other, it involves a product dimension of provisional understandings which can be more or less sophisticated.

Students' experiences of understanding

Students' experiences of understanding have recently been explored by educational researchers. In a series of interview studies, the phenomenon was investigated as students prepared for examinations (Entwistle & Entwistle, 1992; Entwistle & Entwistle, 1991). They described their experiences of understanding as feelings of coherence and "wholeness". Understanding was about making connections between details and wholes, and about integrating new information with previous knowledge (Entwistle, 1995). The students' experiences differed in terms of the breadth and depth of their understanding, and in terms of the structure they used to make sense of the material. Some students used structures from lectures or books, while others worked out their own structure, which could be experienced as an integrated whole (Entwistle & Entwistle, 2003; Entwistle & Marton, 1994). Students have also been found to differ in their approaches to understanding and how they dealt with details (Fyrenius, Wirell & Silén, 2007). Some students considered the relation between details and wholes unproblematic and linear. In other words, they thought that learning more details led to greater understanding. Other students focused on either details or wholes when they studied, as they felt these were competing aspects, and some students believed details and wholes evolved together and worked together to improve understanding. The students' experiences in the studies described above all involve a sense of connectedness between details and the whole. It seems that *"when students reach a deep personal understanding, it has a holistic quality for them, and brings together related ideas along with the supportive detail that also makes it academically acceptable. This type of understanding is not just integrated, it becomes actively integrative, as it pulls in additional related ideas to create an enlarged understanding."* (Entwistle, 2009:56).

Developing understanding is more than a cognitive process; it also involves emotional, perceptual and social aspects. The sudden "aha" moment when things fall into place, or being able to follow a lecture, gives students a feeling of satisfaction (Entwistle & Entwistle, 1992; Entwistle & Entwistle, 1991). In addition, the sense of coherence and connectedness makes students feel confident about explaining what they have understood to themselves or to others. A form of perceptual understanding was found

when medical students learned anatomy, suggesting that visualisation of the human body is important for their learning (Wilhelmsson, Dahlgren, Hult & Josephson, 2011).

Both the representational and performance views give valuable insights into aspects of the complex phenomenon of understanding. However, in this thesis understanding is explored from the students' perspective, and the present inquiry is more concerned with how comprehension, or the lack of it, is *experienced* than with what it actually *is*. This places the present research within the *student approach to learning* tradition (Entwistle, 2009; Marton et al., 1997). Understanding is viewed as more than a cognitive process; it involves the whole person, and includes emotional, perceptual and social aspects.

UNDERSTANDING IN MEDICINE

Although the present research project draws mainly on literature within the domain of higher education, the context is medical education. Therefore, an introduction to research on student learning within medical education is presented here. In research on medical education, understanding has been investigated mainly from a cognitive perspective, focusing on the development of expertise and how basic science knowledge is related to clinical knowledge (Schmidt & Rikers, 2007). A series of studies exploring the relationship between knowledge of basic science and clinical diagnosis comes within the scope of this thesis. The basic sciences (including cell biology, biochemistry, anatomy and physiology) are often learned during the first years of medical education, and are thought to provide a solid base for learning the clinical sciences (Kaufman, Keselman & Patel, 2008). In a series of experiments it was shown that making use of biomedical causal explanations to reason about clinical cases enhanced medical students' understanding of the relationship between symptoms and diseases (Woods, Brooks & Norman, 2005, 2007a). Furthermore, understanding the underlying mechanisms of diseases seemed to be important in diagnosing difficult clinical cases (Woods et al., 2007b). These findings were confirmed by Ahopelto and co-workers (2011). They found that students with a deep understanding of biomedical knowledge performed better in a clinical assignment than students with limited understanding. Relevant knowledge of the basic sciences would appear to be important not only to novice medical students but also to experienced clinicians when they are interpreting clinical cases (Nielsen, Gotzsche, Sonne & Eika, 2012). Taken together, these research findings suggest that a deep understanding of the basic sciences is a major factor in the ability to solve clinically relevant tasks, and this is the case for novice medical students as well as experienced clinicians.

Learning is contextual, and students' experiences of understanding in different disciplines is likely to be influenced by their perceptions of the nature of the discipline (Anderson & Hounsell, 2007; Newton, Newton & Oberski, 1998). Students' understanding of physiology and anatomy has recently been explored from a phenomenographic perspective (Fyrenius, Silén et al., 2007; Fyrenius, Wirell et al., 2007; Wilhelmsson, 2010). These studies showed that medical students differed in their perceptions of learning the subjects. Their concept of studying anatomy was to learn a detailed body of material and to link it to three-dimensional structures in the body (Wilhelmsson et al., 2010). Memorising details of anatomical structures was

challenging, and students constructed meaning in different ways, such as relating the structures to their function, or to the importance of knowing the anatomy of the human body for their future profession. Contextualisation was important, as anatomical knowledge alone did not seem to be sufficient to create meaning (Wilhelmsson, 2010). Physiology is concerned more with different processes in cells and organs, which are interrelated in complex ways. Research has shown how students sometimes misunderstand physiological phenomena and have difficulties understanding how underlying physiological principles apply to different situations and systems (Modell, 2000; Michael, 1998). Understanding physiology involves more than being able to explain causal relationships. It is about comprehending the complexity of biological systems and the ways in which they are regulated, and reaching this level of understanding can be difficult for students (Fyrenius, 2006; Fyrenius, Silén et al., 2007).

Multimodal experiences appear to be important for medical students' learning, and the opportunity to see, smell and touch has been shown to help students develop a deep, integrated understanding of the medical sciences (Hindmarsh, 2007; Pandey & Zimitat, 2007; Wilhelmsson et al., 2010). Medical education involves complex situations, where emotional, visual and tactile experiences can facilitate or, in some cases, obstruct understanding. For instance, studying a human corpse through dissections or autopsies can be valuable. It can help students understand the three-dimensional structure of the body and where organs are located in relation to one another, but it can also cause anxiety and distress (McNamee, O'Brien & Botha, 2009; Penney, 1985; Smith & Kleinman, 1989; Wilhelmsson et al., 2010).

Scheja and Bonnevier (2010) found that medical students experienced understanding as a gradual development, and that they missed having a sense of the "big picture" in the early years of their education. However, the students seemed to be comfortable with the apparently slow development of understanding. Where topics reappeared in different courses, their understanding developed as things fell into place. Their understanding was transformed significantly as they entered the clinical phase of their education, where knowledge from the different pre-clinical courses was integrated into a larger whole and a more general understanding of medicine as a discipline.

STUDENTS' WILL TO LEARN

Learning is sometimes difficult. It can be frustrating to study hard and still not understand. It can also be boring, or students can feel pressured to meet the assessment requirements. Learning requires effort and a will to persist. Learning can also be inspiring and rewarding, when we succeed and learn things we initially found difficult. Regardless, the key to learning lies in the motivation and the will to learn. Barnett suggests that *"At any level of education, a pupil, a student cannot make serious progress unless she has a will to do so. Unless she has a will, a will to learn, she cannot carry herself forward, cannot press herself forward, cannot come successfully into new pedagogical situations."* (Barnett, 2007:15).

Motivation is about students' drive to engage in a certain activity or task (Pintrich, 2003). Motivation is a construct that involves motives, will and interest, as well as engagement, and which influence students' study behaviour. In the present thesis, motivation will be regarded as an educational phenomenon that significantly influence student learning. Students differ in their motivation to learn and study, and their will to engage in learning may come from a number of different sources. Some students are mainly motivated by external factors, such as obtaining a reward (pass assessment requirements) or avoiding failure. In contrast, intrinsic motivation originates from a genuine interest to learn and understand for oneself (Biggs & Tang, 2007; Brophy, 1998). Interest in the subject has been associated with a deep approach to learning (Biggs & Tang, 2007). Students who are interested in the subject or task at hand are also more likely to spend more time learning and put more effort into it, which in turn has been shown to have positive effects on the learning outcome (Schiefele, 1991).

From an understanding point of view, therefore, intrinsic motivation is considered more effective. However, it is not particularly realistic to expect intrinsic motivation from all students at all times in educational settings. In fact, it is more common when people are engaged in activities they have chosen themselves, and in which they are genuinely interested (Brophy, 1998). Brophy offers the concept of "motivation to learn", which takes the special conditions of educational settings into account. In education, the curriculum content, and the teaching and learning activities, are selected by teachers, influenced both by their teaching traditions and what society believes students should learn. Teaching takes place mainly in groups, and each individual student's needs cannot be met at all times, so sometimes students will be frustrated, bored or positively challenged. Furthermore, their performances are assessed and graded, which tends to make them concentrate on successfully meeting the demands of the assessment. By the concept of "motivation to learn", Brophy (1998:12) means *a student's tendency to find academic activities meaningful and worthwhile, and to try to get the intended learning benefits from them. […] Students who are motivated to learn will not necessarily find classroom activities intensely pleasurable or exciting, but they will take them seriously, find them meaningful and worthwhile"*.

Learning tasks need to be valuable to students. They must find them meaningful and challenging at their level of competence, so that they feel they can complete the task successfully (Brophy, 1998). If these criteria are met, students are more likely to engage in a learning task and experience the pleasure of being completely absorbed by a problem. They are also likely to feel the satisfaction of mastering and understanding something difficult as a result of hard work and effort (Bruner, 1977). However, if the task is too hard or too easy, or if the students do not expect to succeed, they may give up entirely, or invest only minimal effort in order to meet external requirements and no more.

Alienation and engagement

Recently, a number of authors have offered an alternative framework for understanding student learning in higher education by conceptualising learning in terms of *alienation* and *engagement* (Case, 2008; Mann, 2001). The perspective of alienation and engagement could provide a broader and more contextualised view of students'

learning experiences, as it also takes approaches to learning and motivation into account. When students adopt a surface or strategic approach to learning, focusing on memorising and unreflective reproduction or on assessment requirements to improve their marks, they may be alienated from the subject and the process of engaging deeply in meaningful learning (Mann, 2001). The concept of alienation includes the experience of entering a new discourse as a "stranger in a foreign land", not fully understanding the language or the rules of the game. Academic disciplines have their particular ways of thinking and practising, and form boundaries with other disciplines (cf. Kreber, 2009). The student entering a new discipline is an outsider, and may or may not feel comfortable joining and engaging in the particular disciplinary discourse. While alienation involves *disconnection*, an experience of being isolated from a group or activity, engagement represents a *connection* and involvement (Mann, 2001). Engagement is multi-dimensional. It entails the active and interactive behaviour of students, as well as cognitive dimensions such as self regulation and a will to learn. It constitutes a deep approach to learning, and takes into account emotional factors such as interest, enthusiasm and a sense of belonging (Kahu, 2011).

Vermunt and Verloop (1999) provide additional insights into the concept of engagement in their detailed analysis of the variety of activities students use for learning. They categorise these activities as cognitive, affective or regulative. Cognitive activities involve processing, such as relating, analysing, selecting, memorising, structuring and applying. Affective learning activities are where students create strategies to cope with emotions which arise during learning. These include maintaining a willingness to learn, how to deal with failure, concentrating, paying attention, judging oneself and ascribing value to learning. The third domain includes activities involving metacognitive regulation, such as planning, monitoring, adjusting, evaluating and reflecting. Students differ in their use of learning activities, and as a result some are more engaged in learning than others. The concepts of alienation and engagement may best be understood as a continuum where students can be more or less engaged and connected to the task at hand, the course, the discipline, studying at university as a whole and the social aspects of being a student.

There are still relatively few empirical studies from the broader perspective of alienation and engagement. A study by Case (2007) found that students were alienated when they focused on self-discipline and drudgery in response to curriculum overload, but when they were passionate about their studies and future profession they became engaged and enjoyed the course. The study also found that, in large classes, students tended to interact only with a limited number of other students. Opportunities to interact with other students in small group activities during the course were positively welcomed by students. They also appreciated enthusiastic lecturers who inspired them to engage in the discipline. The finding that teachers have an important role in engaging students was also reported by Bryson and Hand (2007) and McCune (2009). In the study by Bryson and Hand, this was mainly described in terms of the lecturers' lack of enthusiasm, their use of too many slides or their tendency simply to read the slides, all of which were disengaging for students. The students in McCune's study, on the other hand, noted how they had been inspired by their teachers' enthusiasm for the subject area, which had encouraged them to engage in learning. The way in which the students were taught and assessed also contributed to how engaged they were. Their willingness

to become involved was influenced further by authentic learning experiences, where the tasks were perceived to be relevant and realistic in relation to the discipline and their future profession (McCune, 2009).

To summarise, students' will to learn, and their willingness to engage in learning activities, are multi-dimensional. These factors are influenced by how students perceive aspects of the learning environment, as well as their motives, intentions and learning strategies, and how they cope with emotional aspects of the learning situation.

3 DESIGNING TEACHING TO FACILITATE UNDERSTANDING

This chapter summarises essential aspects of teaching, and models of curriculum and course design relevant to this thesis project. Teaching is central to all formal education, and is a multi-faceted phenomenon which can be conceptualised in a number of different ways. Teaching is always planned and designed by someone, and choices are made regarding the "what" and "how" aspects of teaching. The "what" aspect involves the content, the material students are required to learn in a particular course or activity. The "how" aspect involves the kind of teaching and learning activity (TLA) used to facilitate learning of the content. One way of thinking of teaching is in terms of the variety of activities teachers are engaged in (Ross & Stenfors-Hayes, 2008). These activities include preparation and planning, selection and organisation of course content, giving a lecture, leading a seminar, organising a group discussion among students, writing assessment tasks and making judgements about students' performances. Some of these activities are performed in the classroom, in interaction with students, while others take place before or after classroom-based learning. In this thesis, teaching is viewed as all the activities teachers undertake, before, during and after classroom interaction, to facilitate students' learning. However, teaching is more complex than the activities themselves. Teachers experience teaching in different ways, which can be described as: "teaching as telling", "teaching as organising student activity" and "teaching as making learning possible" (Ramsden, 2003). In the first concept, teaching is a matter of transmitting information to students, and the activities often include lectures, where sufficient information can be presented efficiently. The second concept focuses more on activities where students learn in an active way. The third concept is more complex, and views teaching as a process where teachers and students interact. Communicating with students is regarded as important in assessing their learning, and in helping them to develop an in-depth understanding of the subject. Teaching methods have been shown to be influenced by the way teachers understand teaching and learning, as well as by their understanding of the subject matter (Lindblom-Ylänne, Trigwell, Nevgi & Ashwin, 2006; Martin, Prosser, Trigwell, Ramsden & Benjamin, 2000; Prosser, Martin, Trigwell, Ramsden & Lueckenhausen, 2005; Trigwell & Prosser, 1997). Teachers with a more atomistic and less integrated understanding of their subject are more likely to focus on transmitting information in their teaching, whereas teachers with an integrated and deep understanding of their subject focus more on facilitating their students' understanding. Each teaching and learning activity entails a pedagogic encounter where students engage with the subject to a greater or lesser extent.

CURRICULAR TRENDS IN MEDICAL EDUCATION

Medical education involves training for a profession. It is therefore complex, and involves both theory and practice. A responsible professional education addresses the knowledge, skills and attitudes the students need to develop in order to become a capable professional (Shulman, 2005). There are a variety of models in medical education, ranging from a focus on discipline to different versions of integrated

curricula. Traditional curricula are often discipline-based, and focus on basic sciences in a preclinical phase followed by clinical courses in the later years of the curriculum. The teacher is seen as the expert, knowledgeable in his or her field. This view of medical education, originating in the work of Flexner who presented the model in 1910, has been common in many medical schools since then, and has been hard to change (Tosteson, 1990). The disadvantage of this type of curriculum is the separation of theory and practice, which may cause a problem of transfer, and difficulties in making practical use of the knowledge acquired in a theoretical context (Bolander Laksov, Lonka & Josephson, 2008). During the last decades, however, there has been a shift in medical education, from teaching regarded as knowledge transmission towards more student-centred teaching methods where the students are actively engaged in constructing their own knowledge. The integration of the basic and clinical sciences seems to have become a standard approach, and problem-based (PBL) curricula have become the most common form of curriculum design in medical schools worldwide (Boud & Feletti, 1997; Harden, 2000). Problem-based education was first introduced into medical education during the 1960s at McMaster University in Canada (Barrows & Tamblyn, 1980). In PBL, students work in small groups with a real life problem or situation as the point of departure. Other TLAs are offered as resources, such as lectures and seminars. PBL curricula are integrated, and are often structured around themes or organ systems rather than disciplines. PBL permeates the entire curriculum, and requires substantial organisational changes to a traditional, discipline-based curriculum (Boud & Feletti, 1997).

Bruner's idea of a spiral curriculum, where topics are revisited and the level of difficulty increases, has been particularly interesting for medical education (Harden & Stamper, 1999), and may be a guiding principle in discipline-based, system-based and problem-based curricula. Bruner (1977) argued that the structure of the subject, or how things are related, is one of the most important aspects to learn. Only by understanding basic ideas and principles is it possible for students to transfer their knowledge and use it in new situations. According to Bruner, this should be at the heart of the educational process. Subsequently, the curriculum needs to be organised to encourage students to revisit the basic and important ideas and principles in each subject repeatedly, building on them and deepening their understanding so that they learn to use them in more complex situations. The solution advocated by Bruner is the spiral curriculum, based on these basic ideas and principles. It suggests that teachers should return constantly to these ideas and principles at progressively higher levels, presenting them from additional perspectives and in ever more detail. This will ensure that students learn what matters most, and that they are equipped to use this knowledge and understanding in their future life.

A more recent curriculum theory is known as Outcomes-based Education (OBE) (Biggs & Tang, 2007; Harden, Crosby & Davis, 1999). The concept central to OBE is a focus on the "product", which in this context means the competent and capable student. The intended learning outcomes (ILO), i.e. the essential knowledge, skills and attitudes we wish the students to develop during their education, should be clearly and explicitly stated, and should guide the choices of what and how to teach and assess. In other words, intended outcomes define the process, as well as the teaching and learning activities which should help students to achieve the ILOs. In this system, there is less

focus on the content itself and more emphasis on student performance and capabilities. Consequently, assessments in an outcomes-based curriculum should be designed so that students are required to perform tasks which are directly aligned with the intended learning outcomes (Biggs & Tang, 2007).

Another way of describing different curricula has been proposed by Jolly (1998). He outlines four major types of curricula found in medical schools: content driven, method driven, assessment driven and outcome driven. The content driven curriculum is often discipline-based, and typically involves a traditional model which separates the basic and clinical sciences. The content driven curriculum, dating back to Flexner, has also been called a "structure-and-process-based" curriculum (Carraccio, Wolfstahl, Englander, Ferentz & Martin, 2002). Method driven curricula have a well thought out pedagogical method which pervades the entire curriculum. This framework includes problem-based curricula. Outcome driven curricula focus on explicit goals, expressed in terms of ILOs or objectives, and teaching and assessment are adapted to accommodate them. Here we find different versions of OBE, which can either be problem-based or discipline-based (Biggs & Tang, 2007; Harden et al., 1999). A competency-based curriculum, which explicitly states the competencies medical students should achieve, is an example of OBE which has gained ground in many medical schools (Carraccio et al., 2002). All curricula are, to some extent, assessment driven. From the students' perspective, the assessment defines the curriculum, and will have a major influence on their studying and learning strategies. This phenomenon has been called the "backwash effect" (Biggs & Tang, 2007). Where intended learning outcomes and teaching and learning activities do not correspond to the assessment requirements, students will often focus mainly on the assessment. From a curriculum perspective, this is more of an unintentional side effect, and has been denoted the "hidden curriculum" (Snyder, 1971). There are also cases where assessment intentionally drives the curriculum, in speciality certification, for example (Jolly, 1998).

DESIGNING COURSES TO FACILITATE UNDERSTANDING

Constructivist learning theories have had a major influence on instructional methods, placing the active, engaged, reflective learner at the centre. The design of courses is important in terms of teaching and learning activities, because it influences what the students do, and in turn what and how they learn (Biggs, 1999). In this thesis, designing teaching to facilitate meaningful learning means that teachers plan and perform TLAs (lectures, seminars, etc.) with the aim of facilitating learning of a specific content. The design of a course and its activities is in the hands of the teachers. They "set the scene", and decide how the content and subject are presented to the students (Selander, 2008). This "scene" could be a theme, situation or problem which students are expected to work with to construct and transform their knowledge and to develop understanding. A number of models of course design are based on a constructivist perspective on learning, and focus on facilitating meaningful learning. Biggs (1996; Biggs & Tang, 2007) argued that, if intended learning outcomes, teaching and learning activities and the assessment are constructively aligned, and are designed to promote and assess meaningful learning, students are more likely to adopt a deep approach to learning. In this model of *constructive alignment*, the emphasis is on conceptual understanding,

constructive learning processes, students' active engagement, and assessment, focusing on understanding and application rather than factual recall. The teaching and learning activities provided should help students to engage actively in meaningful learning, and in turn to achieve the intended learning outcomes. Biggs' model builds on ideas from a framework developed by researchers involved in Project Zero at Harvard - *Teaching for Understanding* - where there is a strong emphasis on conceptual understanding, ongoing formative assessment, active engagement of students and explicit goals which focus on understanding (Wiske, 1998). In the Teaching for Understanding framework, the "scene" teachers set focuses on conceptual understanding, and open-ended topics are chosen to help students understand important aspects of the subject. Equally, the activities or assignments are designed to help students develop a deep understanding, as well as to give teachers an opportunity to assess their performance. Each of these models focuses on content which is especially difficult, so-called troublesome knowledge (Perkins, 1999), or threshold concepts which are essential for a deeper understanding of the subject (Meyer & Land, 2005). Courses and activities are specifically developed to help students understand these. Constructive alignment and the Teaching for Understanding framework are both examples of OBE, and can be used as design principles for single courses or modules, as well as for whole curricula.

Student-centred teaching and learning activities

Each course contains specific teaching and learning activities (TLAs), which are the building blocks of a course. Traditional TLAs, still commonly used in higher education worldwide, involve lectures and seminars. However, as the constructivist view of learning has become more widely acknowledged by educators, the focus has shifted towards more student-centred activities. Examples of methods which are growing in popularity are those where students learn from each other, such as small group activities, peer collaboration, cooperative learning and peer tutoring (Schunk, 2004). In the laboratory, students have been challenged to predict, explain and discuss the experiments and not just to follow the protocol (Modell, Michael, Adamson & Horwitz, 2004). Students still appreciate lectures, though they often become passive listeners (Biggs & Tang, 2007; Ramsden, 2003). However, there are now examples of different ways to engage students actively during lectures (Fyrenius, Bergdahl & Silén, 2005; Steinert, 1999). Other student-centred activities which are becoming common in medical education are case methods where students analyse and discuss clinical cases (Stjernquist, 2001; Tärnvik, 2004) and team-based learning where students solve problems in groups (Haidet, O'Malley & Richards, 2002; Koles, Nelson, Stolfi, Parmelee & Destephen, 2005). In keeping with this shift towards student-centredness, a view of assessment as an integral part of teaching and learning has gained ground in recent years. This has led to the development of a variety of assessment forms, as well as an increasing focus on formative assessment and the importance of feedback (Falchikov, 2005; Hattie & Jaeger, 1998; Hounsell, 2007; Nicol & Macfarlane-Dick, 2006).

STUDENTS' EXPERIENCES OF THE LEARNING ENVIRONMENT

Although teachers have important roles in designing teaching and learning activities which facilitate meaningful learning, students' perceptions of their learning

environment have the greatest influence on their learning strategy. The approach students take has been found to be influenced by a number of factors, both personal and contextual. Personal factors, as mentioned above, include the students' concepts of knowledge and learning, their learning orientation, how they regulate their learning strategies and their motivation to study. Contextual factors involve students' perceptions of the learning environment (Entwistle & Peterson, 2004; Lizzio, Wilson & Simons, 2002; Lonka & Lindblom-Ylänne, 1996; Ramsden, 2003; Trigwell & Prosser, 1991). A heavy workload and assessment which focuses on recall of factual knowledge are factors associated with a surface approach or reproduction-directed learning. A perception of good teaching which focuses on students' understanding and involvement, and assessment focusing on application and conceptual understanding are factors associated with meaning-directed learning. A meaning-directed learning pattern has been shown to have a positive effect on academic performance, whereas reproduction-directed learning has been negatively related to achievements (Lindblom-Ylänne & Lonka, 1999; Lizzio et al., 2002; Van Rossum & Schenk, 1984). One study surveyed students who studied abroad, observing them both before they went away and during their stay. The study found that when students changed the learning environment, they also changed their orientation to learning (Wierstra, Kanselaar, van der Linden, Lodewijks & Vermunt, 2003). In the study, meaning-directed learning was related to a student-centred learning environment which stressed conceptual understanding, whereas reproductive-directed learning was associated with an environment where memorising and recall of factual knowledge were emphasised. When students changed environment in either direction, their learning orientation also changed, which confirmed the relational nature of learning approaches and orientations. However, there seems to be an element of consistency in the learning approach, suggesting that students may prefer one approach over another, or may simply use it out of habit, but that environmental factors encourage them to adapt their approach to a particular situation (Entwistle, 2009).

Researchers have been interested in investigating ways of encouraging students to adopt a deep approach. This may be hard to achieve, however, and educational development initiatives to promote meaningful learning can have unexpected effects on student learning strategies. Instead of promoting a deep approach to learning as intended, an initiative can steer students towards a surface approach to learning (Mattick, 2007; Struyven, Dochy, Janssens & Gielen, 2006). In some cases, however, there is research-based evidence to suggest that student-centred learning environments, such as problem-based curricula, stimulate students to adopt a deep approach. Newble and Clarke (1986) found that medical students in a PBL school were more likely to use a deep approach and less likely to use a surface approach than medical students from a traditional, discipline-based curriculum. Further evidence of this is provided by a study where the same group of students took two different courses: a traditional, lecture-based course and a student-centred course designed to involve students in projects, peer learning, etc. (Wilson & Fowler, 2005). The findings suggested that students who usually adopted a deep approach were consistent in their approaches to learning across the two different learning environments. Interestingly, students who typically adopted surface approaches used more deep strategies in the student-centred course than in the traditional course. The authors suggest that when students are "forced" to be active and involved, and to take responsibility for their own and their peers' learning, they become

more inclined to engage in meaningful learning. Developing learning environments which facilitate meaningful learning and the use of deep approaches is not an easy task. Baeten and colleagues (2010) concluded in a recent review that the research findings on the effects of different teaching and assessment methods, which were designed to promote deep approaches to learning and development of understanding, were both promising and discouraging.

It is evident from this overview that designing student-centred teaching underpinned by constructivist learning theories does not always generate the intended influence on students' approaches to their learning. Models such as constructive alignment (Biggs, 1996, 1999) and the Teaching for Understanding framework (Wiske, 1998) are "ideal" solutions, and provide support and ideas on how to design teaching. In addition, research using inventories to measure students' approaches to learning during a course as a whole, does not provide a sufficiently detailed or nuanced picture of their approach to learning in relation to the different teaching and learning activities offered during a course. There are still considerable gaps in our knowledge about how students engage in learning and develop understanding, and about how teaching influences their learning during their education. Teaching and learning is multi-faceted, and in order to design medical and healthcare curricula which promote meaningful learning and development of understanding, we need to develop a better understanding of the interplay between teaching and learning, and how students arrive at their understanding.

4 AIM OF THE THESIS

The purpose of this thesis is to investigate the interplay between teaching and learning in everyday teaching situations and to obtain a more nuanced picture of how medical students approach their learning on a course in a medical programme. The thesis focuses on the students' journey towards understanding, which was explored by following their experiences of learning and understanding during a nine-week course in their second year. Although the investigation was undertaken in the context of a medical curriculum, the overall aim is also broader and relates to issues in higher education in general. It seeks to gain a better understanding of how teaching influences learning, and focuses particularly on the design of courses and teaching and learning activities. It also investigates how this design relates to students' understanding.

The overall aim is to explore the students' experiences of learning throughout the course as a whole. An exploratory research approach was adopted, which is described in more detail in the next chapter, and I participated in as many teaching sessions that was practically possible. Of all the activities that were offered to students, three stood out as particularly interesting; a case seminar, formative assessments and autopsies. The research team chose to investigate students' experiences of these activities more closely to understand the interplay between teaching and learning in these activities more deeply. This involved:

- investigating students' experiences of an innovative form of case seminar (Study I)
- exploring students' experiences of two different types of formative assessment, and in which ways these act as tools for learning (Study II).
- exploring students' experiences of an emotionally challenging learning situation: the autopsy (Study III).

In the fourth study, the focus was on the course as a whole, and the aim of this study was:

- to explore the students' journey towards understanding and investigate whether, and how, their experiences of learning and understanding changed during a university course (Study IV).

5 METHODOLOGY AND RESEARCH DESIGN

METHODOLOGY

Research in the field of medical education is characterised by a variety of research approaches which have evolved from several different paradigms, such as positivism, interpretivism and critical theory (Bunniss & Kelly, 2010). Medical education is a complex and diverse field where practitioners and researchers from different academic disciplines meet in their aspiration to contribute to the development of theory and/or practice (Albert, Hodges & Regehr, 2007). Some researchers argue that medical education research should be considered a "hard" medical science (Bligh & Brice, 2008), while others claim that the field should be constructed as a "soft" social science (Monrouxe & Rees, 2009). The different views and ideas about how to construct medical education sometimes cause tensions, and there has recently been some debate on issues concerning the epistemology, methodology and purpose of research on medical education (Bligh & Brice, 2008; Bordage, 2009; Bunniss & Kelly, 2010; Cook, Bordage & Schmidt, 2008; Monrouxe & Rees, 2009). It has been emphasised that researchers in medical education need to be more explicit about the assumptions which guide their investigations, and that they need to link their research more carefully to theoretical frameworks (Bordage, 2009; Bunniss & Kelly, 2010; Cook et al., 2008).

Although the research reported in this thesis belongs to the field of the medical education, it is considered to be carried out within social science research traditions. The reason for this position, was clarified by Monrouxe and Rees (2009:198), who wrote, *"Medical education is about people, and the way we think, act and interact in the world"*. The issues investigated in this thesis are both broad and relevant to research in higher education in general, but also specific to medical education. The research was exploratory in nature, and sought to understand and clarify the interplay between teaching and learning. In order to achieve this aim, a qualitative research approach was chosen. A qualitative research approach is appropriate for exploring complex phenomena and gaining a nuanced and deep understanding of the issue under investigation (Patton, 2002). The research was conducted within a constructivist and interpretive research tradition, which acknowledges that data are constructed as a result of interaction between researchers and respondents, and analysis is a process informed by the researcher's prior knowledge and experiences (Bunniss & Kelly, 2010; Denzin & Lincoln, 2003).

Qualitative research approaches include phenomenology, hermeneutics, grounded theory and discourse analysis (Patton, 2002). They differ in terms of their overall purpose and the epistemological basis which underpins each one. The present thesis was conducted from the perspective of exploring students' experiences, a focus which is in keeping with methodologies such as phenomenology and phenomenography. However, the present research took a more pragmatic approach, known as generic qualitative research, where the focus is more guided by the research questions than focusing the study through the lens of a traditional, well established methodology (Caelli, Ray & Mill, 2003; Smith, Bekker & Cheater, 2011). This allows a more flexible approach to research, where the questions guide the choice of approach instead

of *"being too attached to method for method's sake"* (Holloway & Todres, 2003:347). The generic approach to qualitative research has been criticised as having a lack of methodological clarity and coherence (Caelli et al., 2003; Rolfe, 2006). This potential weakness in generic approaches has been addressed in this thesis by making the epistemological basis explicit, and by choosing methods of analysis commensurate with the basic assumptions of a constructivist research tradition.

The present study focuses on learning and understanding, explored from the students' perspective, which places this thesis in the student learning research tradition (Entwistle, 2009; Marton & Booth, 1997; Marton et al., 1997). Learning in this thesis is regarded as both a process and a product, and involves both individual and social aspects. The learner constructs his or her knowledge in interaction with the social and cultural context (Lincoln & Guba, 2003; Vygotsky, 1978). Scheja and Bonnevier describe this epistemological stance in the following way (2010:248): *"Learning as a powerfully context-dependent process involving a dynamic interplay between learners' personal experiences and capabilities, and their conceptions of the learning environment."*

This thesis investigated students' experiences of the teaching activities offered as part of a particular university course, and their experiences of learning and understanding. The focus was not on their experiences of the medical phenomena themselves, i.e. diseases in different organs, which constitute the "what" aspect or direct object of learning (Marton & Booth, 1997). Instead, the focus on the present research was on the "how" aspect of learning, and included both teaching and learning. Furthermore, the experiences of others were explored, i.e. from the second order perspective.

Although it is not possible to tap directly into the experience of another human being, researchers can, through interviews and written accounts, obtain a version which more or less reflects the respondents' actual experience. This is a limitation shared by all research claiming to investigate other people's experiences. From a constructivist research point of view, the data are considered to be generated as a result of interaction between researchers and respondents, which supports the idea that the data are not a true reflection of the respondents' experiences. Using interviews and written accounts as a way to explore other people's experiences is common in educational research, and even though this method of data generation is limited, it is still worth analysing the data, as it gives insights into aspects of learning from the learner's perspective.

CONTEXT OF THE STUDIES

The present research was carried out within an undergraduate medical curriculum at Karolinska Institutet, Sweden. Karolinska Institutet is a research-intensive medical university with a broad range of medical, dental and health care education at both undergraduate and graduate level. The medical undergraduate curriculum, at the time of data collection, had a traditional discipline-based design with two years of basic sciences (e.g. cell biology, anatomy, physiology, pharmacology) followed by clinical courses (e.g. surgery, medicine) for three and a half years. The pathology course at the end of the second year formed the context of this thesis. At this point, the students were

familiar with studying at the university level. This course was chosen as it represented a typical basic science course, in terms of course design, with a focus on lectures but also involving student-centred activities, which are described in more detail below. Furthermore, regarding the content, the pathology course was a bridge between the basic sciences, with a focus on the structure and function of the normal human body and its systems, and the clinical sciences, focusing on diseases and their treatments. In short, pathology is the study of mechanisms of diseases and their symptoms, and is an essential part of medical curricula. For these reasons, the pathology course was a suitable study object for the present investigation.

The course extended over nine weeks and consisted of two parts: general pathology and organ-specific pathology. The first part, general pathology, focused on basic concepts and processes, such as how cells are affected by stress and damage, which can cause inflammation or diseases like cancer. This part of the course was lecture-based, and culminated in an individual, written, formative assessment at the end of two weeks. The second part lasted for seven weeks and involved organ-specific pathology. Diseases in different organs such as the liver, kidney and heart were presented by different physicians, each an expert in one of these areas. During this part of the course there was a mixture of teaching and learning activities, including lectures, different types of seminars (see below) and autopsies. About five weeks into the second part of the course, students were given an oral formative assessment where they solved clinically relevant problems in groups. At the end of the course there were two summative assessments, one in groups and one in the form of an individual, written exam. The course is outlined in Figure 1 below.
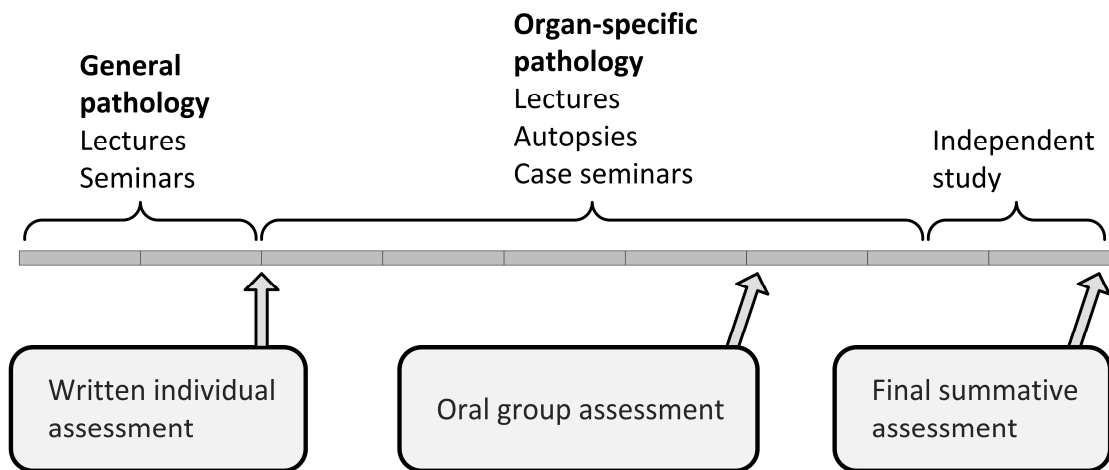

Figure 1. An overview of the nine-week pathology course

A description of the teaching and learning activities

Lectures: Lectures were often given by a physician, an expert in one of the sub-specialties of pathology. Lectures lasted between one and two hours and often took the form of a monologue. Students received handouts from the presentation the teachers gave. The lectures were not compulsory, but the majority of students attended them. There were 37 lectures during the course, fourteen of which were held during the first two weeks.

Seminars with microscopic images: During these seminars a teacher guided the students through a series of microscopic images of tissue. The teachers often encouraged the students to participate by asking them questions on what they saw. There were nine different seminars of this kind during the course, focusing on different areas of the content. The students were required to study microscopic slides by themselves and were assessed at the end of the course, when they were required to describe the microscopic picture and formulate a possible diagnosis.

Case seminars with surgical specimen: These seminars consisted of two sessions, called "macro" and "discussion". During the macro session, students worked in small groups with one or two surgical specimens and a written patient history, and their task was to evaluate and describe what they saw in the macro specimen and to attempt a diagnosis. The groups had different cases and at the end of the seminar the students presented their case to their peers and explained the disease, its causes and its mechanisms. At the end of the seminar the students received a handout detailing all the patient histories covered in the seminar, and were asked questions on the diseases. A couple of days after the macro session, there was a discussion session where pathology teachers went through the cases with the students again. There were three seminars of this kind, focusing on gastrointestinal diseases, gynaecology and renal pathology.

Autopsies: During the pathology course, students were required to participate in a minimum of three autopsies. The autopsies were conducted as a routine medical procedure by pathologists at the affiliated hospitals and the students attended the autopsies in groups of 6-8. To prepare students for their first autopsy, one of the teachers gave a lecture to explain the purpose and the procedure of autopsies, and students were allowed to ask questions and voice any concerns. Otherwise, there was no further introduction to the autopsy room or the procedure. The students did not take an active part in the autopsies, but were to some extent allowed to touch and examine organs.

Formative assessments: Two different formative assessment methods were used: an individual written assessment which focused on recall of factual knowledge, and an oral group assessment which required problem solving. The individual assessment consisted of about 25 questions requiring short answers on general pathology, and was held after the first two weeks of the course. Students received feedback after a couple of weeks in the form of right/wrong answers. This assessment was not compulsory, but if they completed it successfully, it gave them a few credits towards the final summative assessment. The oral group assessment focused on clinically relevant problem solving and was performed in groups of 8-9 students. The group assessment was conducted after about seven weeks and focused on parts of the organ-specific pathology. The assessment consisted of five different clinical cases. The students were given cards with different pieces of information regarding the cases. These included patient histories, laboratory test results, printed microscopic images and images of surgical specimens, as well as written descriptions of tissues and organs, and written information on the mechanisms of the diseases. Some of the cases were quite similar, and additional cards were included with information irrelevant to the cases. The task was therefore challenging for the students, and entailed matching the different cards to

the patient histories for each case, like a kind of puzzle. The students spent 90 minutes solving the cases and then explained their solution to a teacher. The teacher gave immediate feedback. This assessment was compulsory, and students needed to pass in order to be allowed to sit the final summative assessment.

Summative assessment: The final summative assessment at the end of the course consisted of two parts. The first part was a group assessment and involved questions which focused on understanding and elaboration. Students discussed the questions in the group and wrote answers together. Three days later, the students took part two, which was an individual, written exam.

RESEARCH DESIGN AND DATA COLLECTION

The overall aim of this thesis was to investigate the interplay between teaching and learning in everyday teaching situations, and to obtain a more nuanced picture of how students approach their learning and develop understanding during a university course. The pathology course, described above, in year two of the medical programme was chosen as the context for the study. The research design was inspired by an ethnographic approach (Aspers, 2007) where participant observation helped me gain considerable insight into teaching and learning practice on this particular course. This research approach enabled me to capture both my own impressions and the students' perspectives and experiences of teaching and learning in a natural setting, i.e. the everyday teaching context. Triangulation was established by using several data collection methods, and by the fact that different academic backgrounds were represented within the research team (an academic developer and teacher, a physician and teacher, and educational researchers) (Thurmond, 2001).

Data were gathered throughout the course, which influenced the possibilities for data gathering. I followed the course and participated in as many of the teaching sessions as was practically possible. I chose not to observe the autopsies. After reading and hearing about the students' experiences of the autopsies, I anticipated that I would experience a similarly strong emotional reaction, which could have had a negative effect on me and interfered with the subsequent data gathering. Course documents were collected, such as the core curriculum, formative assessments etc. The data collection methods that were used to gather data from students were a) an open-ended questionnaire, b) written accounts, c) group interviews and d) individual interviews. Data were gathered in *three phases* as described below. A convenience sample was used in each phase, which meant that all students taking the course were asked to participate, and students who volunteered to participate were included in the studies. However, the students varied in terms of gender, age, ethnic background and their prior experiences of higher education, and this ensured a breadth of views and experiences.

A summary of the data used in each study is provided below.

Table 1. A summary of data used in the different studies

Study	Phase	Participants	Data
Study I	1	53 students out of 60	Questionnaire with open-ended questions after one of the case seminars.
Study II	2 and 3	Written accounts from seventeen students and group interviews with seven students in phase 2. Group interviews with nine students in phase 3.	Written accounts (2x17, 34 in total) and group interviews (2x2) gathered after each formative assessment.
Study III	2	Written accounts from seventeen students and group interviews with seven students in phase 2.	Written accounts gathered after the first and third or fourth autopsy and a group interview after their first autopsy.
Study IV	2	Written accounts from seventeen students and group interviews with seven students in phase 2.	Written accounts and group interviews at five different time points during the course.

Phase 1: In the first phase, we were interested in how students perceived the case seminars which used surgical specimens. Students taking the pathology course in the autumn term of 2006, who participated in the case seminars, were asked to answer an open-ended questionnaire consisting of two questions. 53 out of 60 students volunteered to participate in the study. The questions concerned their perceptions of the case seminars (see description above), and the students answered them anonymously on paper, immediately after one of the seminars. In order to understand the context, I participated in two of the case seminars. The questionnaire was chosen as a data collection method as it was easy to distribute information and gather data during an authentic teaching session. During this phase the data for Study I were gathered.

Phase 2: During the second phase of the project, the main body of data was gathered. It was also during this phase that I followed the course and observed a majority of the teaching sessions. Two groups of students were recruited from those participating in the course during the autumn term of 2007. Seven students participated in group interviews, and another group of seventeen contributed their reflections in writing. The purpose of combining individual written accounts and group interviews was to obtain richer data and to triangulate data collection (Thurmond, 2001). The first group of students was interviewed on five separate occasions, spread evenly across the course (see Figure 2 below). The group interviews were semi-structured and performed in a relaxed manner; all students were encouraged to participate actively. The interviews were both performed and transcribed in Swedish. The questions asked were broad and open-ended, and addressed students' experiences and perceptions of the teaching and their learning at different times during the course. Group interviews have the advantage of stimulating interaction between participants (Patton, 2002) and were chosen as a way to capture the voices of several students within a limited time frame. In response to a set of questions, an additional sample of seventeen students reflected in writing on

particular aspects of the teaching and on their experiences of learning and understanding. Questions and answers were exchanged by e-mail. E-mail was chosen as a way of gathering data for a number of reasons (Selwyn & Robson, 1998). Firstly, all students had access to student accounts which they checked regularly. Secondly, it was an easy and adaptable way of gathering data from a reasonable sample size in the middle of a course. Thirdly, it seemed as a "friendly" and anti-hierarchical way of communicating. The questions (two or three in each mail) were sent to the whole group simultaneously, but the students were able to answer at their convenience, within a couple of days. Of the seventeen students in the e-mail group, four were international exchange-students. The focus of interviews and questions for the written accounts, were guided by my own reflections from observing the teaching, reading the written reflections and listening to the group interviews. Although the overall research questions remained the same during the project, the specific focus of each group interview and e-mail sent to students developed over time. In addition to the two groups of students that were followed during the course, eight students were interviewed individually after they had finished the course. Four of the students participating in these interviews had not taken part in the previous group interviews. We aimed to interview students with different experiences, and selected informants on the basis of age, gender and number of years of experience of previous university studies. These interviews explored their perception of central concepts and phenomena in pathology, and their experiences of learning during the course. For Studies II, III and IV, different aspects of the data gathered during Phase Two were used. In Study II, written accounts and group interviews held after each formative assessment were used, in Study III, data from written accounts and group interviews concerning experiences of the first and third or fourth autopsy were used. In Study IV, data from all five occasions of the written accounts and group interviews were used, which made it possible to analyse the students' journey.
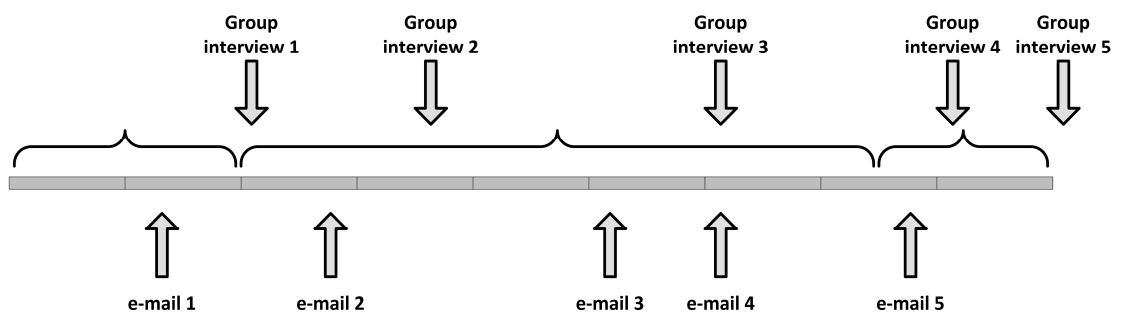

Figure 2. An overview of the data collection during Phase Two. The line in the middle represents the pathology course (see also Figure 1). The arrows indicate when group interviews were held and when e-mails were sent to students at different occasions during the course.

Phase 3: As the analysis of the data from Study II proceeded, we wished to validate the findings. In the third phase, we gathered data in the form of group interviews with nine students who took the pathology course in the autumn term of 2008. A convenience sample was used, and the students were recruited at the beginning of the course. Two interviews were held, one after each formative assessment (in weeks two and seven). The interviews were semi-structured and were conducted in a relaxed atmosphere. All

students were encouraged to participate. The interviews were performed and transcribed in Swedish. These data were used in Study II.

METHODS OF ANALYSIS

All four studies were analysed inductively using qualitative content and thematic analysis methods. These research methods allow systematic analysis so that data can be described and interpreted, and patterns (themes) observed in the data (Boyatzis, 1998; Braun & Clarke, 2006; Elo & Kyngäs, 2008; Hsieh & Shannon, 2005). Critics of content and thematic analysis consider it too simplistic, noting that it only gives a description of the data (Cavanagh, 1997). Despite this, content and thematic analysis have been growing in popularity and have been used both inductively (data-driven) and deductively (theory-driven) (Braun & Clarke, 2006; Elo & Kyngäs, 2008). These methods have the advantage of being content-sensitive and flexible in terms of research design. They can also be as simple or complex as the researcher requires, and can be used to interpret textual data obtained from interviews, open-ended responses to questionnaires and documents, and data from observations (Neuendorf, 2002). Furthermore, content and thematic analyses are compatible with several research paradigms, including the constructivist paradigm, and were considered suitable analysis methods for the present research.

Qualitative analysis involves interpretation of data at several stages during the analysis process (Elo & Kyngäs, 2008; Hsieh & Shannon, 2005). However, the depth of interpretation can differ, depending on the aim of the analysis. Content and thematic analyses are very similar; both methods interpret the content of the data. The methods and their level of interpretation can be placed along a continuum, from a rather simple interpretation of the manifest content in the data to an in-depth analysis of both the manifest and latent content (Braun & Clarke, 2006; Graneheim & Lundman, 2004). The former focuses on the surface meanings or manifest content, and the analysis proceeds from *description*, where data are organised and summarised to show patterns in the manifest content, to *interpretation*, in an attempt to theorise the significance of the patterns and their broader meanings and implications (Braun & Clarke, 2006; Graneheim & Lundman, 2004). The latter goes beyond the manifest content and examines potential underlying meanings, ideas, conceptualisations and assumptions in the data. Braun and Clarke (2006:84) suggest that *"for latent thematic analysis, the development of the themes themselves involves interpretative work, and the analysis that is produced is not just description, but is already theorized."*

Thematic analysis is considered more exploratory than content analysis, although the level of interpretation may vary in both methods, and they overlap considerably. In this thesis, the term thematic analysis is used to describe a more thorough interpretation which goes beyond the manifest content. To analyse qualitative data is to interpret and make sense of it, and to see new meanings in the data (Gustavsson, 2000). When we interpret, we see something *as something* (Asplund, 1970). The result of a thematic analysis is themes, which capture something important about the data in relation to the research question (Braun & Clarke, 2006). It is also possible to make different types of analysis: rich descriptions of the entire data set or a detailed and nuanced account of

one particular aspect within the data. The theoretical stance taken in the present research is an "experience-distant" approach (Gustavsson, 2000). This means that the data, in the form of written accounts and interview transcripts, were analysed without any claim to having captured the meanings the respondents attributed to their experiences, i.e. how the respondents interpreted their experiences. Within a constructivist paradigm, there is not considered to be one single interpretation, but many possible interpretations of the same data. Boyatzis (1998:1) states that "*thematic analysis is a way of seeing. Often, what one sees through thematic analysis does not appear to others, even if they are observing the same information, events or situations*". The analysis focuses on the texts and the researcher interprets their meaning, informed by his or her own experiences and prior knowledge.

The process of analysis was slightly different in each of the four studies, though all four involved repeated readings of the data, iterative, inductive and open development of codes, categories and themes, and constant comparison between the developing categories and themes and the original data. The analysis process does not proceed in a linear fashion; it flows back and forth, and can sometimes be experienced as quite chaotic (Elo & Kyngäs, 2008). Somewhere along this dynamic process of engaging deeply with data, there is a significant moment of clarity, when a new pattern can be discerned. Thereafter, this pattern needs to be confirmed, elaborated and discussed with all members of the research team. Quite often, the pattern is adjusted and fine-tuned, and categories are collapsed or separated further before the final findings are developed. A description of the analyses made in the four studies is presented below.

In Study I, the content analysis focused on the manifest level and used open coding, where the codes originated from the data (Elo & Kyngäs, 2008). The data were coded line by line and then grouped into categories. Each category represented an aspect of the data, and the categories were discussed with all authors to ensure that they fitted the data well and were internally coherent and consistent (Braun & Clarke, 2006). The data were analysed as one data set, and individual students' utterances could be grouped into one or more categories. The categories developed were then interpreted in the light of theory and previous studies.

In Study II the analysis focused on both the manifest and latent level of the content. The coding procedure was inspired by the bottom-up, data-driven approach used in grounded theory (Charmaz, 2006). All data, interview transcripts and written accounts were treated as one data set. Data were coded line by line, and the codes developed from the data were clustered into groups with similar codes. In the initial stage of the analysis, the analytical themes were constructed around the two different assessment methods. This changed as the analysis moved to a more abstract level, and the emphasis shifted to formative assessments as tools for learning. Throughout the analysis process, memos were written in order to document every step of the analysis. The themes and categories were regularly compared to similar themes, as well as to the original data (Charmaz, 2006). The analysis and construction of themes were thoroughly discussed within the research team throughout the process.

Study III used a thematic analysis approach inspired by hermeneutical interpretation (Gustavsson, 2000). The analysis focused on the latent level of the content and during

the analysis "meaning units" (sentences or short paragraphs) were interpreted in relation to the whole data set. This analysis produced more of a holistic interpretation, and the themes which were constructed were on a more abstract level than those in the two previous studies. The analysis process was documented as before, discussed in detail and agreed by all members of the research team to ensure coherence and consistency of the findings (Braun & Clarke, 2006).

The fourth study focused on students' experiences during the course, and all the transcripts and written accounts were first read several times to get a broad sense of how the students experienced the teaching and learning. As in the previous study, the thematic analysis was inductive and focused on the latent level, i.e. the underlying meaning (Boyatzis, 1998; Braun & Clarke, 2006). The second step in the analysis was to extract and code utterances in the data which were related to understanding in some way. The extracted data were further interpreted, aiming for a detailed and nuanced account of students' experiences of learning and understanding during that particular course. The themes were constructed in terms of different forms of understanding, and labelled with metaphors which captured the essential meaning of each form of understanding. The analysis was continuously discussed with all authors, and notes were taken as a way of enhancing the transparency of the analytical process. In order to ensure internal coherence and consistence, and a good fit between data and findings, the themes which were developed were discussed and agreed by all authors

TRUSTWORTHINESS

The quality of the research is as important for qualitative inquires as it is for quantitative studies. The research findings should be trustworthy, regardless of the research approached used. Trustworthiness involves the extent to which the research findings are believable and plausible (Koch & Harrington, 1998). There are, however, different views on which concepts to use in discussing and describing trustworthiness in qualitative research (Graneheim & Lundman, 2004; Rolfe, 2006). Some researchers argue for using the concepts commonly used in quantitative research traditions, such as validity, reliability and generalisation. Other researchers claim that since qualitative research is fundamentally different, other concepts are required to describe trustworthiness (Koch, 1994; Koch & Harrington, 1998). It has become common to describe it using the concepts of *credibility*, *dependability* and *transferability* (Graneheim & Lundman, 2004). Several researchers go even further and argue that it is not possible to agree on universal criteria for judging and evaluating the quality in different qualitative inquiries. They argue instead that the research will be judged on its internal coherence and suggest that the investigator take a reflexive approach throughout the research process (Koch & Harrington, 1998; Rolfe, 2006). Koch and Harrington (1998:887) claim that: *"if the research product is well signposted, the readers will be able to travel easily through the words of the participants and makers of the text (the researchers), and decide for themselves whether the text is believable or plausible (our terms for rigour)."* Researchers are responsible for making the evidence which leads to a decision visible and transparent, so that readers can follow how researchers have arrived at their findings (Koch, 1994). In the present research project, I will use the concepts of credibility, dependability, transferability and reflexivity to

discuss trustworthiness of the present research and how the process was made transparent.

Credibility

Credibility refers to confidence in the whole research project, the choice of methodology, how participants were selected, how data were gathered and analysed, and how well these addressed the focus of the study (Graneheim & Lundman, 2004). In other words: are the researchers investigating what they intended to investigate, and are the findings congruent with the research question and the participants' utterances? Credibility is also about how well the categories and themes developed fit the data. One of the strategies used to ensure credibility during this project involved the researcher observing the teaching sessions during the course in order to gain insight into the context of the study and to become more familiar with it (Aspers, 2007; Shenton, 2004). Although convenience sampling was used in all three phases of the project, participants varied in terms of age, gender and ethnic background, as well as in terms of their prior experiences of higher education. They also represented the breadth of the student population as a whole. This ensured a variation in the participants' experiences and views.

Another way in which the credibility of the project was enhanced was by triangulating data collection methods (Thurmond, 2001). Throughout Phase Two of the project, data were collected from two groups of students (in the form of group interviews and written accounts). Investigator triangulation was also involved, in the sense that the project team consisted of researchers with different professional backgrounds (a pathologist, teacher and medical researcher, an educational developer and teacher, and two educational researchers). This contributed to a variety of experiences and perspectives within the research process. I undertook the first stage of data analysis myself. In order to make the process transparent, notes and memos were written throughout, and were read and discussed by the project team. Furthermore, the coding, categories and themes were constantly compared to the original data as they were being developed, in order to ensure a good fit between data and findings. They were then thoroughly discussed with all researchers until consensus was reached (Braun & Clarke, 2006).

Peer scrutiny of the research at various stages in the process is a way to bring fresh perspectives and perhaps illuminate assumptions made by the researcher (Shenton, 2004). The Centre for Medical Education has a supportive culture of peer review, and findings were presented and discussed with fellow doctoral students and researchers throughout the process. In some cases, this resulted in refinement of the findings. The manuscripts were read and reviewed by colleagues prior to submission. The findings were also been presented at international conferences on research in the fields of medical and higher education.

Dependability

Dependability involves the consistency of data collection and analysis procedures in the research process (Graneheim & Lundman, 2004; Silverman, 2006). Qualitative inquiry is often explorative, and data collection is an evolving process (Graneheim & Lundman, 2004). Each interview, for example, will be slightly different, even though it

covers the same areas. This was not a problem in the present research project, since group interviews were conducted, and each interview focused on different aspects of teaching and learning. Furthermore, the questions used to stimulate students to reflect on their experiences in writing were the same for all students in the e-mail group. The analysis process was documented in notes and memos, and remained transparent to all members of the research team. By making the research process transparent, describing the data collection and analysis method in sufficient detail, it is possible for readers to follow the "decision trail" and make judgements about consistency (Silverman, 2006; Koch, 1994). Furthermore, the connection between findings and data was made transparent by including quotations from students in articles for publication.

Transferability

Transferability refers to the usefulness of the findings in other contexts (Shenton, 2004). The findings of qualitative inquiry are dependent to the specific context in which the investigation was performed, but transfer may be possible, and the findings may be used to understand or shed light on similar phenomena in other settings (Larsson, 2009). Transferability can be enhanced by maximum of variation in the sampling, i.e. recruiting participants with different backgrounds and experiences. As described above, the students in our studies varied in terms of gender, age and ethnic background, as well as in terms of their prior experience of higher education. Transferability of findings also involves similarity of context (Larsson, 2009), and since it is the reader who makes judgements about whether findings are transferable, it is important that the researcher describes in enough detail the characteristics of the context, the participants and the process of analysis (Graneheim & Lundman, 2004). The context of the present research has been described and emphasised in each of the studies to make it possible for readers to judge the extent to which the findings are transferable. Furthermore, *"transferability may be helped by the study's discussion of how its results advance theoretical understandings that are relevant to multiple situations."* (Kuper, Lingard & Levinson, 2008:688). The usefulness of the findings in a study also involves the communication of patterns (Larsson, 2009). Qualitative research results in interpretations and analytical themes or categories, patterns of a sort, which can be recognised in other situations or settings where the context is more or less similar to the original. The findings of all four studies in this thesis can be viewed as patterns which can be recognised in other settings. For example, Study I concluded that a form of case seminar was perceived by students to be important for their learning. The analysis resulted in four aspects: the case seminars stimulated the students' intrinsic motivation, facilitated learning and understanding, helped to place theoretical knowledge in a real life context and gave them an important opportunity to learn collaboratively. This pattern of motivation, knowledge construction, context and collaboration can be found in other educational situations which facilitate meaningful learning, and may even be a point of departure when designing learning activities.

Reflexivity

Reflexivity involves recognising the influence a researcher brings to the research process (Lincoln & Guba, 2003). It emphasizes the potential power relationships between the researcher and participants which could shape the resulting data (Kuper et al., 2008). We need to reflect critically on ourselves as researchers and *"come to terms*

not only with our choice of research problem and with those with whom we engage in the research process, but with our selves and with the multiple identities that represent the fluid self in the research setting" (Lincoln & Guba, 2003:283). In qualitative research and analysis, it is important to reflect on how the researcher's own presuppositions may influence data gathering, and to be conscious of this fact and open about it.

I have a background as a cell biologist, secondary school teacher and educational developer at Karolinska Institutet. I therefore had comprehensive experience and sound knowledge of teaching and learning when I started this research endeavour. My biological and biochemical knowledge helped me to grasp at least the basics of the content of the pathology course, and I could recognise the kind of knowledge and understanding highlighted in the teaching sessions. In one sense, it gave me an insider perspective on the pathology course. My teaching experience and knowledge about research on student learning, on the other hand, sometimes made me reflect on the way the teaching was designed and carried out, and what I would have done differently. I was aware of this, and allowed the thoughts to enter my mind, but took care to focus on the research questions when observing the teaching sessions. Taking notes helped me to focus on what was actually happening, instead of evaluating the teaching. I also discussed my observations and thoughts with my supervisors, in order to focus on the research questions.

I had no relationship to the students or teachers other than as a researcher. Since I participated in many of the teaching sessions during the course in Phase Two of the project, the students grew accustomed to my presence. I became a person, not just a name. This may have contributed to a relaxed atmosphere between me and the participating students, and could possibly have influenced their willingness to share their personal experiences during group interviews and in the written accounts sent by e-mail. The research approach I used - to observe authentic teaching - is likely to have had an influence on both teachers and students. It was not possible for me to become "a fly on the wall", or be completely invisible and observe "unaffected" teaching. I tried to keep a low profile, and in the lecture hall I sat among the students, but it is likely that the knowledge of my presence affected the teaching, perhaps in a positive direction.

ETHICAL CONSIDERATIONS

The study followed national and international ethical guidelines on research involving human subjects. Ethical approval was obtained from the local Board of Ethics. All participants were informed about the purpose of the research project and what participation in the study would involve. This information was presented to the students at the beginning of the course and written, informed consent was obtained from all students prior to data collection. Participation was voluntary, and the integrity of the students was protected at all times. No sensitive information was collected about the participants, and the students could at any time, without consequences, terminate their involvement in the study.

The study was conducted within an authentic course, and the students' need to study for their final exam at the end of the course was respected. I sat among the students and tried not to draw attention to myself. Both teachers and students were informed, orally and in writing, about the research project at the beginning of the course. It was made clear to the teachers that their teaching would not be judged or evaluated, and that they had the opportunity to ask me not to participate in their teaching sessions. However, no one made this request and I was welcome to participate in all the sessions. It was also made clear to the students that their choice of becoming involved or not would not in any way affect their course results.

6 FINDINGS

The present investigation consists of four studies, and this chapter presents the main findings. The studies all explored students' experiences of teaching, learning and development towards understanding, but each focused on different aspects of the pathology course. Studies I, II and III looked more closely into three different teaching and learning activities which were a well established part of the course. These activities were especially interesting since they seemed to influence students' learning significantly. The activities were: a form of case seminar using surgical specimens (Study I), two different methods of formative assessment (Study II), and autopsies (Study III). Study IV broadened the scope of the previous studies and investigated the students' experiences throughout the course.

STUDY I

This study evaluated a form of case seminar, described in the previous chapter, which has formed part of the lecture-based pathology course for several years. The case seminar was designed to emphasise problem-solving and peer learning, and was clinically relevant. The purpose of this study was to investigate the ways in which these case seminars contributed to learning as perceived by the students.

We found that all the students appreciated the case seminars and felt that they complemented the lectures well. The case seminar seemed to contribute to the students' learning in several ways. The analysis highlighted four aspects which were important for learning: motivation, knowledge construction, context and collaboration. The *motivational* aspects involved increased interest and motivation to learn. The students found the seminars stimulating, fun, inspiring and interesting, and this seemed to increase their willingness to study. The students found the seminars a good way to learn: *"You learn much more from these interactive studies than just listening to lectures."* The *knowledge construction* aspects, illustrated by the quote, included enhancing memory and facilitating the students' understanding of diseases and their mechanisms. Students reported that the experience of seeing and feeling the surgical specimens was important for their learning. The case seminar also helped the students to relate textbook knowledge to a real world context and their future profession, which can be described as the *contextual* aspects of learning. Furthermore, according to the students in our study, the work in small groups resulted in positive *collaborative* learning. Working with the cases in small groups gave the students an opportunity to discuss, elaborate and ask questions.

Learning is complex, and we believe that these four aspects are intertwined and influence learning in a number of ways. For instance, learning theoretical knowledge in a relevant context can evoke students' interest and help them see the bigger picture. This, in turn, helps them to gain a deeper understanding of the subject matter. Discussions with peers can give them new insights which also facilitate understanding. The opportunity to touch and see real organs with tumours or other kinds of pathological changes seemed to be especially important for the students, and helped them to relate their theoretical knowledge to real life clinical cases.

As a teaching and learning activity, the case seminar appeared to influence students' learning significantly. The task was designed to stimulate reflection and application of knowledge, whether individually or with peers. Our findings suggest that the students who engaged in the activity made connections between theory and reality, and started to develop a deeper understanding of diseases. Our conclusion is that the design of this case seminar was successful, and encouraged students to participate actively in the activity, which is a condition for meaningful learning. The perceived authenticity of the clinical cases, the problem-solving aspect of the task and the collaborative work in small groups may be the ingredients which made this design successful from a learning perspective.

STUDY II

Formative assessment is common in many courses as a means of motivating students to study, facilitating their learning and assessing their level of knowledge acquisition. In the pathology course, two different formative assessment methods were used, an individual written assessment which focused on recall of factual knowledge, and an oral group assessment involving problem solving. The two formative assessments were quite different. One concentrated on right/wrong answers, individual performance and delayed feedback, whereas the other focused on understanding/problem-solving, group performance and immediate feedback. The individual assessment largely reflected an "assessment as knowledge control" approach and the group assessment reflected the concept of "'assessment as learning". This study aimed to gain a better understanding of students' experiences of formative assessments. Specifically, it explored ways in which these two methods of formative assessment acted as tools for learning.

Our findings suggest that the two types of formative assessment motivated students to study, made them aware of what they had learned and indicated where they needed to study more (see Figure 3). The formative assessments influenced the students' motivation to study in several ways. For many students, the formative assessments seemed to act as external motivators and pressurised them to study. We also found evidence of intrinsic motivation, such as a growing interest in the subject as a result of studying for the assessments. Moreover, an assessment task can be stimulating and challenging in itself, and thereby trigger intrinsic motivation. We found that, in addition to influencing their motivation, formative assessment gave students feedback on their progress, which in turn made them aware of their own learning. The experience of whether or not they were able to complete the task or answer the questions gave students an indication of how much they had understood and where more study was required. In other words, the students themselves reflected on their own progress and weaknesses in relation to the assessment tasks. The formative assessments also gave students clues about which aspects of the course were more important for them to learn, i.e. what kind of questions might be included in the final exam, and which information they would need to answer them.

Formative assessments contributed to the students' learning both by influencing the learning process (how students learn) and the learning outcome (what they learn). The

students felt they learned by explaining their thinking to others, either by formulating a written answer to a question in the individual assessment or by expressing their views orally and reasoning aloud during the group assessment. Many students mentioned that they learned basic facts and details about diseases and obtained an overview of the subject, a sort of brief map of the content. Moreover, by reviewing the assessment and the experience of completing the assessment task, students seemed to be able to structure their knowledge and obtain a sense of "wholeness" or interconnectedness, helping them to see the "bigger picture" and make connections with the real world.
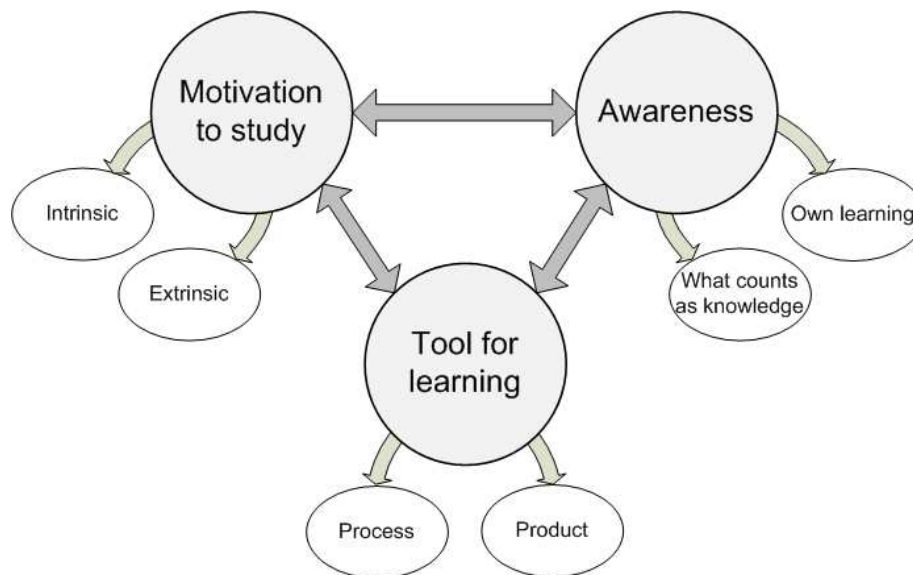
Figure 3. A model of students' experiences of formative assessment as a tool for learning

A closer look at the students' experiences of each form of assessment reveals interesting differences. The group assessment seemed to stimulate intrinsic motivation and helped the students understand how knowledge is related, so that they developed a sense of "wholeness". The group assessment forced the students to think from the patient's perspective and helped them understand the relationship between theoretical knowledge and the professional context. Discussing and developing ideas with peers also facilitated the learning process. The individual assessment, on the other hand, triggered extrinsic motivation and was largely experienced as control of knowledge retention. The students appeared to learn basic facts and terminology, and obtained an overview of the subject.

Both assessments functioned as tools for learning in several ways. Firstly, the students were motivated to study for both assessments, and in doing so they learned more. Secondly, the assessments made students aware of their own learning and what counts as knowledge in the course. Thirdly, the assessments influenced both what and how the students learned. The design of the assessment had a clear influence on the students' experiences. Assessments which focus on problem-solving and application, where students need to analyse, reflect and explain their thinking, are more likely to facilitate the development of deep understanding. Since the design of assessment tasks lies with the teacher, assessment also functions as a tool for learning from a teacher's perspective. If teachers understand how different assessment designs influence student

learning, they can use them thoughtfully and combine different forms of assessment throughout a course or educational programme.

STUDY III

Another teaching and learning activity which significantly affected the students during the pathology course was the autopsy. Traditionally, medical students participate in autopsies during their undergraduate studies. Although autopsies have been used in medical education for a long time, studies investigating students' attitudes and experiences of autopsies are rare. The autopsy is likely to be emotionally challenging for students and will be remembered for a long time. During the pathology course, students were required to participate in a minimum of three autopsies. The purpose of the present study was to explore students' experiences of autopsies and the ways in which autopsies can offer important learning opportunities.

Students experienced the autopsies in three different ways: as an unnatural situation, as a practical exercise and as a way of learning how pathologists work. These three themes differed in terms of the aspects of the experience which were most prominent, how the body was perceived, and the extent to which students distanced themselves from the situation (see Table 2).

Table 2. An overview of the themes representing different ways of experiencing the autopsy

Theme	Focus	Perceptions of the body	Emotional reaction	Learning	Dimension of closeness - distance
Autopsy as an unnatural situation	The unnaturalness of the situation	A human being – with family and friends	Strong emotional experience - unpleasantness	Some knowledge of anatomy and pathology, and how autopsies are performed.	Emotionally close – physically distant
Autopsy as a practical exercise	The pathology course	A specimen – objectified	Emotions of unpleasantness, but able to cope – interested	Repetition of anatomy and learning pathology, clinical relevance.	Emotionally distant – physically close
Autopsy as a way to see how pathologists work	The clinical practice	A patient	Emotions of unpleasantness, but able to cope – interested	Mainly how autopsies are performed and cause of death is determined.	Emotionally distant – physically close

For some students, the first autopsy was such an emotional experience that they had difficulty coping with their anxiety. Their experience centred on the *unnatural nature of the activity* and the awkwardness of the situation, and some students experienced feelings of nausea and were afraid they would faint. These students found it hard to concentrate on what was happening during the autopsy, and some felt they did not learn much from the experience. Others felt they had learned some anatomy and pathology.

The students used words such as "bizarre" and "surreal" to describe their experiences. The body was perceived as a human being who had recently been alive. The teacher had an important role in guiding students through the procedure. Clear guidance helped the students to have a meaningful experience despite their strong feelings of anxiety. However, some students noted that guidance was lacking, which made it even more difficult to cope with the unpleasantness of the situation.

Students who experienced the autopsy as a *practical exercise* saw it mainly as part of the course, and their goal was to revise anatomy and learn pathology. The opportunities to see, smell and touch the organs were important to the students' learning. The autopsy gave them a clinical link to the course content (pathology), which seemed to help them in their learning. The students seemed to cope with the unpleasantness of the situation by taking an objective approach to the body and distancing themselves from the situation mentally and emotionally. They talked about the body using words such as "specimen" and "body" or only spoke about it in terms of specific organs. Autopsies where students saw "new" pathological changes were considered more meaningful. A good introduction to the procedure and clear guidance were important for the students. This helped them to focus on what they found, and relate it to previous autopsies.

Students who approached the autopsy as a *way of learning how pathologists work* concentrated on professional aspects of the procedure. The body was seen as a patient, and students used words such as "body", "patient" and "person" when they described their experiences. The students seemed to remain focused on the purpose of the autopsy, an investigation into the cause of death, as a way of coping with the unpleasantness. This also involved students distancing themselves from the situation, trying not to involve their emotions. This theme also highlighted the importance of a good introduction and clear guidance from the teacher.

It is important for students to address the strong emotions evoked in the autopsy room if they are to engage in productive learning. In fact, the students gradually became accustomed to the situation, and subsequent autopsies were not as difficult as the first one. During the later autopsies the students either appeared to relate to the purpose of the autopsy, or focused on learning anatomy and pathology. In this way, they shifted the focus from an unnatural situation to perceiving the autopsy as a practical exercise (the second theme) or a way of learning how pathologists work (the third theme).

There seems to be no linear development through the phases where students first experience the autopsy as an unnatural situation, then as a practical exercise and finally as part of the clinical work of pathologists. Instead, it is more likely that their experience of autopsies depends on the aspects they focus on (for example learning course content or observing clinical practice). In this way, some aspects become part of the foreground of their experience, and others remain in the background. Students seem to contextualise the same situation differently, and the aspects they pay attention to influence their interpretation of the situation and what they gain from the experience.

As a teaching and learning activity, autopsies are both interesting and problematic. Teachers have no control over the choice of autopsy cases. The situation is more of a master-apprentice relation, where the pathologist demonstrates how autopsies are

conducted while the students observe and do not take an active role in the procedure. However, clear guidance through the process was found to be important for students, involving them by asking questions which encouraged reflection and analysis. This helped many of them to cope with the unpleasantness of the situation. The autopsies were emotionally challenging for all students, but afterwards they appreciated having been given an opportunity to participate. They considered it important for all medical students to witness at least a few autopsies during their medical training. Although the teacher cannot plan the situation completely, or choose relevant cases, the findings of our study may help teachers to be aware of the different ways an autopsy can be experienced. It may encourage them to give their students a clear understanding of the purpose of the autopsy, guide them through every step of the procedure and actively involve them by asking questions.

STUDY IV

There is a substantial body of knowledge about student learning in higher education, but students' experiences of understanding has only recently been explored by educational researchers. The aim of this study was to capture the "journey" towards understanding of a group of students during a pathology course.

We discovered four themes which capture the students' experiences of learning and understanding: *understanding as knowing the language* (A), *understanding as knowing the map* (B), *understanding as knowing the catalogue* (C) and *understanding as experiencing an integrated whole (*D). The themes represent different forms of understanding, and overlap to some extent. For instance, in order to understand the catalogue you need to have an overview of the course material (the map) and understand the subject-specific terminology (the language).

In the first theme (A), understanding entailed to "knowing the language". The understanding in this theme was rather limited, and focused on grasping the meaning of key concepts and basic processes. However, the students needed this understanding in order to proceed in their learning. The learning process seemed to focus on studying and rehearsing the terminology, concepts and basic processes, in much the same way as one learns a new language.

The second theme (B) was characterised by a concept of understanding as "knowing the map", and involved a rather rough outline or overview of the content of the course. The learning process involved browsing through the course literature, making mind-maps or other graphical tools in order to reach a sense of overview and "see" the map. It could also involve listing the main points and learning the basic facts and concepts, which also resulted in a sense of overview and map of the content. This superficial map seemed to help students to structure the course content, so that they could more easily navigate the vast amount of information involved. Details and facts were constantly added to this map as the students learned more.

Understanding in the third theme (C) was viewed as "knowing the catalogue", and it involved a lot more detail than the two previous themes. The students described the

learning as "cramming", and focused on trying to learn as many details as possible. The students experienced the knowledge as fragmented, organised as a form of catalogue, so that they focused on each organ and its diseases, e.g. the heart, the kidney, the liver, etc. Some students expressed frustration over the vast amount of information they were required to learn, and seemed to give up trying to develop any sort of deeper understanding.

In the fourth theme (D), understanding involved the development of an "integrated whole", and was qualitatively different from the previous themes, representing a deeper and more comprehensive understanding. The learning process entailed making connections between facts and concepts, and between prior and new knowledge, and it resulted in a sense of "wholeness" and coherence. Visual impressions and the opportunity to touch real organs (during practical exercises in the course) seemed to be important, and facilitated the development of an integrated whole. Two subthemes emerged, one where the focus was on a deep, integrated *understanding of the subject* (D1), and one with a focus on *understanding reality* in new ways (D2).

A time dimension emerged in our findings. The students described starting a new course as being thrown into chaos. They felt that there were lots of new concepts and terminology, and they did not know which of them was most relevant to learn. To cope with this "information chaos", the students at first seemed to approach their studies by either learning the concepts and terminology (the "language", theme A) or obtaining an overview of the course content (the "map", theme B). By choosing one of these approaches, they could learn the other (illustrated by Pathways 1, 2 and 3 in Figure 4). Their need to be able to navigate the course material and learn the basic concepts early in the course was salient in our data, and seemed to be the aim of all the students in our study.
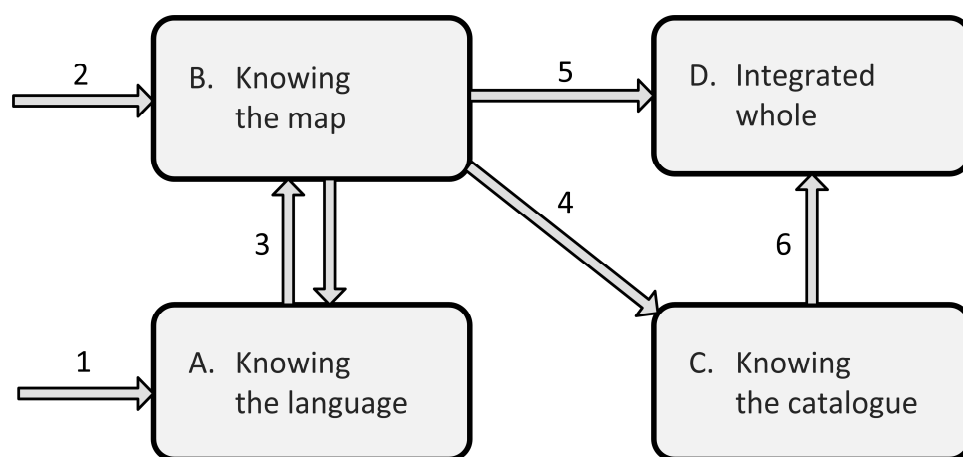

Figure 4. Potential pathways to achieving deeper understanding

However, during the course, with more and more information to be learned, some students appeared to focus on learning as many details as possible about each disease, and ended up structuring their knowledge as a catalogue (theme C). This is illustrated as Pathway 4 in the figure above. Other students made connections and looked for similarities and differences between diseases, with a view to understanding the material at a deeper level (Pathway 5). Some students, on the other hand, seemed to be trying to

integrate their knowledge into a whole, but were focusing on learning the catalogue as a step towards deeper understanding (Pathway 6). We also found that students achieved a deep understanding (theme D) of some parts of the course content, but the sheer amount of information meant that they ended up "knowing the catalogue" for other parts.

PRELIMINARY FINDINGS

Preliminary findings from the analysis of data from Phase Two (written accounts, group interviews and notes taken from observations) have not been presented in the four studies described above. A brief overview of these findings will be presented here, as they are relevant to the aims of this thesis.

The students described their experiences early in the course as relatively chaotic. They were presented with many new concepts and terminology they did not understand. As the students got to grips with their learning, they focused on different forms of understanding as presented in Study IV. The preliminary analysis of other parts of the data reveals the students' experiences of the teaching and learning activities offered during the course. Some aspects helped students and facilitated their learning, and others passed them by or made learning more difficult for them. Their learning was also influenced by emotional dimensions.

A. Providing support and guidance
1. Help in knowing what to learn
These aspects included measures taken by teachers to help students learn what they needed in order to pass the assessment requirements. They involved covering "core curriculum" (syllabus) in the lectures, giving an overview of some of the content in a lecture and providing good, readable handouts. Students appreciated teachers who clearly described the microscopic pictures of tissue, and teachers who gave clues on what was relevant and important to know. They also valued the written, individual assessment early in the course, but particularly appreciated anything which helped them to "know what to study for the exam".

2. Facilitating understanding
Some aspects also facilitated the development of understanding, such as lectures where pictures of organs were presented, or examples of real patients with diseases were discussed. Students also valued opportunities to discuss a theme with peers or to ask questions in interactive lectures or seminars where students discussed small cases with peers for a few minutes. They felt this encouraged understanding. Seminars were considered helpful for developing understanding if students were encouraged to think for themselves first and then the teacher guided them by asking questions. Seminars were also helpful for relating theory to clinical findings and gave them an opportunity to discuss with peers or teachers. The case seminar and the oral group assessment used clinical cases as a point of departure, which the students considered important. In the second half of the course, the students appreciated the mixture of teaching and learning activities, i.e. lectures, different kinds of seminars and autopsies. There was also more time for independent study.

B. Making learning more difficult

1. Obstructing learning

Overall, students were pleased with the lectures, but at the beginning of the course they felt there were too many lectures in a day. These lectures often tended to be monologues, and students found themselves becoming passive listeners, which hindered their learning. Many students found it difficult to concentrate during the lectures. As there were so many lectures, there was less time for independent study, and students felt they did not have time to keep up with the course book. Students also had difficulties seeing the bigger picture and grasping the relationship between different slides, which were presented serially in the lectures, one after the other. The vast amount of information they were required to learn made some students focus on "cramming".

2. Lack of time for reflection and discussion

Although the lectures were often appreciated, the students felt they needed more seminars. They wanted more opportunities to discuss with peers and to ask questions when they did not understand. They also wanted more time for independent study, and would have liked questions on the content, which they could have worked on by themselves or with peers. They sometimes felt lost in all the information and would have appreciated more structure and help in making connections.

C. Emotional aspects

1. Worry and concern

When students did not know what they were supposed to learn or what they were expected to do, they felt worried and concerned. Confusion about what to study for the two formative assessments, and unclear practical information regarding the autopsies also caused concern. They were worried and confused by the experience of not being able to see the bigger picture and feeling overwhelmed by all the information with no clear structure. Some students doubted their own learning strategy and were worried that the usual ways of studying would not be sufficient this time.

2. Safety and confidence

Although students were worried and concerned, most of the students felt confident that they would pass the assessment requirements. They had been in this situation before, and could cope with the worry and confusion. They also felt safe when topics reappeared and they could recall relevant knowledge, or if they experienced "aha" moments when things fell into place. By obtaining an overview, a map of the course content, students felt secure and in control of their learning. Summaries written by students who took the course the previous year were popular, and students were keen to get hold of them. They gave them a sense of security and confidence that they were learning the most relevant information.

These preliminary findings suggest that the students, for the most part, appreciated the teaching and learning activities offered throughout the pathology course. There were aspects of the course that clearly facilitated students' learning and development of understanding, and that made students feel confident and in control of their learning.

However, there were also aspects that were an obstacle for learning, and made students worried and concerned.

To sum up, the findings presented in this chapter describes various aspects of the students' experiences of the teaching-learning environment in the pathology course, and how different activities interacted with their learning and development of understanding. These findings will be discussed in the following chapter.

7 DISCUSSION

The research presented in this thesis set out to explore students' experiences of learning and understanding during a course in a medical programme, in order to improve our knowledge of how teaching influences learning. The students in our study appeared to be motivated to study hard and to understand the content, not simply to pass the assessment requirements. Previous research has shown that students are sensitive to the learning environment and adopt either a surface, deep or strategic approach to learning (Entwistle & Ramsden, 1983; Marton & Booth, 1997; Marton & Säljö, 1997). The findings of our study, presented in this thesis, suggest a more complex picture of how students approach their learning during a particular course. They indicate that the design of the course as a whole, and the different teaching and learning activities involved in it, influence their learning and understanding in various ways.

STUDENTS' JOURNEY TOWARDS UNDERSTANDING

The students in Study IV appear to have aimed for understanding, but they had a substantial amount of detail to learn and integrate into a coherent whole in a limited time frame. This was not an easy task, and the students' endeavour could best be described as a struggle. They described their experiences early in the course as chaotic, and found it hard to know what was relevant. At first, the unknown terminology was an obstacle to their learning, and worry and confusion were common emotions during these first weeks. The focus of the students' journey at the beginning of the course seemed to be, first and foremost, to manage this chaos. The long hours each day left little time for independent study, which meant they had to rely on browsing lecture notes and reading summaries written by other students, instead of reading the course literature. However, the students were used to this situation. "*It is like this every time, in every new course,*" one student said. Nevertheless, they lacked structure and a bird's-eye view of the course content, and would have preferred teachers to have provided a clearer overview. Although students thought there were too many lectures a day at the beginning of the course, the majority of them attended the lectures. These gave students something of an overview, and some lecturers were good at presenting their material in a structured way, which students found helpful. It is not surprising that students first aimed at "knowing the language" and "knowing the map" (Study IV). This can be considered a constructive approach to dealing with the terminological and structural aspects of the subject area, and these forms of understanding seemed to work as levers for further learning. They provided gateways into the content and helped to develop a deeper understanding.

As the weeks went by and the students became involved in their studies, they began to focus on how to manage the vast amount of information. This part of the course involved a variety of teaching and learning activities which helped the students to structure and process the information. Seminars were appreciated, as they provided opportunities to ask questions and to discuss the topics. The lectures focused on organ-specific pathology and were presented by different teachers, experts in their field. Some students adopted the structures from lectures and the course literature, developing an understanding which could be termed "knowing the catalogue". Other

students seemed to develop their own structure as they read and studied the lecture notes and literature. They looked for similarities and differences, made connections beyond the organ-focused structure and developed a more integrated understanding. Similar differences have been found in the various ways students understand material when they are revising for exams (Entwistle & Entwistle, 1992; Entwistle & Entwistle, 1991).

Our findings point to potential pathways students might take towards developing a deep understanding (see Figure 4, page 41). All the students appeared to focus on the two more limited forms of understanding: "knowing the language" and "knowing the map", as discussed above. The individual written assessment during the second week stimulated, or pressurised, students to begin studying early in the course, as shown in Study II. As they studied for this assessment, focusing on learning the basic concepts and terminology, they simultaneously developed an overview of the content. In the subsequent weeks, some students aimed for a deep understanding and actively related the material to prior knowledge and personal experiences, trying to make connections to relevant contexts and achieving "understanding as an integrated whole". Other students focused on learning as many details about each disease as possible, using the structure from the lectures and course literature. However, some students managed to develop an integrated understanding of all or parts of this catalogue-like knowledge. The journey towards understanding may therefore involve different learning strategies, including memorising, which is in agreement with findings from other studies (Entwistle & Entwistle, 2003; Kember, 1996; Marton, Wen et al., 2005). One aspect which seemed to obstruct students' development towards understanding was information overload. Some students gave up and resigned themselves to learning the catalogue, while others developed a deep, integrated understanding of certain parts of the content, and a more catalogue-like knowledge of other parts. All students believed it was sufficient to acquire "knowing the catalogue" in order to pass the final exam.

The present thesis provides a close-up portrait of a typical basic science course in a traditional and disciplined-based medical curriculum. The journeys towards understanding discussed above are likely to be the result of a complex interplay between the discipline, the particular course design and students' learning, including earlier learning experiences from other courses in the study programme. However, the patterns which emerge may also apply to similar courses and contexts. A discussion follows below on the disciplinary aspects of understanding. It examines engagement and alienation in terms of the students' experiences of learning and understanding during the pathology course. Finally, the thesis discusses designing for understanding and the interplay between teaching and learning.

DEVELOPING UNDERSTANDING IN MEDICINE

Learning always has a learning object; we learn *something*. In this thesis, this something is pathology, the mechanisms of diseases. Each discipline and subject has distinctive ways of thinking and practising (Anderson & Hounsell, 2007; McCune & Hounsell, 2005) and what counts as understanding in one subject differs from other subjects (Newton, 1999; Newton et al., 1998). Entwistle (2009) uses the concept of the

"inner logic of the subject" to describe specific ways of thinking and practising. What characterises medicine as a discipline? Medicine can be viewed as one discipline, consisting of several subjects. The subject of this thesis, pathology, is one of the basic sciences in medical education, but it also provides a bridge to the clinical sciences. Learning pathology was experienced by the students (Study IV) as learning terminology and concepts, and obtaining a brief map or skeleton of the content to which details could be added as their learning progressed. All the students focused on learning details, but some related the details only to the particular organ, and ended up with a catalogue-like understanding of pathology. Other students looked for relations and connections, trying to see the theoretical knowledge in a real life context, comparing and looking for similarities and differences, and by doing this they developed a more integrated understanding. A similar pattern, where students differed as to how they related details to "wholes", was found in a study of medical students' learning and understanding in physiology (Fyrenius, Silén et al., 2007). In this study, some students related details and whole concepts to each organ, and some could describe processes related to blood flow but were unable to relate them to similar processes in other parts of the body. This limited understanding, where students fail to recognise underlying principles, has also been described by Modell (2000), who argues that it needs to be addressed in teaching. Many students do not notice the general principles by themselves, and fail to make the connection between organ systems and similar situations. The "knowing the catalogue" type of understanding found in the students in Study IV can be seen as an example of this organ-specific focus. Only when they deliberately look for similarities and differences between processes in different organs or situations do students develop an understanding of underlying principles. Some students apparently do this by themselves (Fyrenius, Silén et al., 2007) which was also the case in our study.

Where the "inner logic of physiology" involves complex biological systems, anatomy is characterised by learning the structure of the human body. Anatomy entails large quantities of detailed knowledge of body parts, and their relation to the whole structure of the human body. Learning all these details can be tedious, and studies have shown that students create meaning by relating the structures to their functions, or by focusing on the importance of anatomical knowledge for their future profession (Wilhelmsson et al., 2010). There is evidence that some students continue to memorise information, while others combine rehearsal strategies in an effort to understand the structure of the whole body (Pandey & Zimitat, 2007). They consider anatomy to consist of learning terminology, which is similar to the "knowing the language" type of understanding found in our study. The "inner logic of pathology" can be said to be a combination of the main characteristics of physiology and anatomy. Pathology entails mechanisms and processes of diseases, as well as a knowledge of how a change in one organ affects the body as a whole. It also involves learning a substantial amount of detail regarding each organ-specific disease. The students in our study seemed to perceive pathology in one of two ways. The first approach was to try and understand the human body as a complex system, how and why diseases occur in certain organs and how disease in one organ affects the body as a system. The second approach involved learning about organs and their related diseases in a catalogue-like manner. Interestingly, each of these concepts of the "inner logic of pathology" focuses on one of the two characteristics described above.

Medicine can be described as learning about the human body, and visual and tactile experiences appear to be important for this process. Learning is not only cognitive, it also involves the "hand" and the "eye" (Hindmarsh, 2007; Pandey & Zimitat, 2007; Wilhelmsson et al., 2010). This was also salient in our data, and students appreciated the opportunity to touch different organs and examine diseases first hand during the case seminars (Study I). The autopsies helped students to develop a better understanding of diseases and how they affect the whole body (Study III). However, the anxiety some students experienced during the autopsies and anatomical dissections hindered their learning (McNamee et al., 2009; Penney, 1985).

The students in our study considered their understanding to develop gradually over time. Studying a new course entailed learning the basic concepts and terminology, and creating a brief map to help structure the content. As the weeks went by, the students studied diseases organ by organ, and their understanding developed slowly. Some students appeared to give up on their quest for a deeper understanding because of the vast amount of detail they were required to learn. Others tried to understand the whole and learn details simultaneously. Fyrenius, Wirell et al. (2007) described a similar pattern of different relations between details and the whole, classifying them as linear, competing or collaborating. Some students thought their understanding grew as they learned more details in a linear way, while others felt they had to focus either on grasping the whole or paying attention to details, as they could not learn them simultaneously. Some felt they developed understanding by learning details and the whole simultaneously. During the pathology course, students also mentioned that they had "aha" experiences where previously acquired knowledge, which they had not fully understood, suddenly fell into place. This was common in cell biology, physiology and anatomy, for example. These experiences could take place during a lecture, a seminar, when students were working together or when they were working by themselves. It was normally preceded by a lack of understanding, where students had been struggling to understand something from a previous course. In the context of a discipline-based curriculum, like this one, where topics reappear from time to time, the students' journey towards understanding seemed to develop gradually, with specific "aha" moments now and then. Students seemed comfortable with this delay in understanding, and did not expect to understand the subject at the beginning. They trusted the system and believed that everything would eventually fall into place (Scheja & Bonnevier, 2010). Interestingly, this is in contrast to engineering students, who expressed frustration and considered the delay in understanding an obstacle to their learning (Scheja, 2006).

ENGAGING STUDENTS IN MEANINGFUL LEARNING

The concepts of alienation and engagement (Case, 2008; Kahu, 2011; Mann, 2001) will be used here to discuss the findings from the present investigation. The first two studies explored students' experiences of different teaching and learning activities which formed part of the pathology course: a case seminar using surgical specimens (Study I) and an oral group assessment (Study II). These activities appear to have influenced the students' learning significantly, and engaged the students in a number of ways. For example, both tasks required the application of knowledge to solve

problems the students had not encountered before. These were the kinds of activity which put the students' understanding to work, and at the same time helped them to develop and deepen their understanding (Perkins, 1998). To carry out the tasks, students had to analyse the information available, recall relevant knowledge from memory, relate and compare what they saw to what they already knew, discuss and elaborate possible explanations with peers, draw conclusions and present a solution to the problem (Vermunt & Verloop, 1999). These rather demanding cognitive processes required effort, and students had to pay attention to the task. The students in our studies mentioned that these activities helped them to understand mechanisms of diseases better, relate theoretical knowledge to real life examples and develop a sense of "wholeness". It is possible that when students are forced to relate and compare different diseases and mechanisms, they restructure their knowledge into a more integrated whole, a process described by Piaget as accommodation (cf. Fosnot, 1996). Furthermore, the discussion and elaboration in small groups may have helped to activate prior knowledge, which has been found to be essential for meaningful learning (Ausubel et al., 1968; Burns et al., 1991). Problem-solving in groups is an essential feature of problem-based learning, and requires dialogue and discussion which can also help to activate prior knowledge and facilitate learning of new information (Dillenbourgh, 1999; Dolmans & Schmidt, 2006; Norman & Schmidt, 1992). Our preliminary findings showed that lectures and seminars were more likely to engage students and facilitate understanding if students were allowed to think for themselves first, or teachers helped them to relate to clinical cases. The way students carry out learning activities is not only influenced by the task requirements, but also by how they understand knowledge and learning, their intentions and approach to learning and their preferred learning activities. These can be summarised as an overall learning pattern (Vermunt & Vermetteren, 2004). Students who normally rely mainly on memorising and repetition may experience a constructive friction in these learning activities and become stimulated or challenged to use higher level learning and thinking strategies (Vermunt & Verloop, 1999). Other students may experience congruence with the same activity, if they master the activities and use them spontaneously. No evidence of destructive friction emerged from our data. In other words, students found the tasks neither too difficult nor too easy.

In addition to the cognitive aspects discussed above, the case seminar and the oral group assessment also captured the students' interest, and they found these activities stimulating and meaningful. One student mentioned that her confidence was boosted when the group managed to meet the challenge of the group assessment and arrived at the correct diagnosis. These findings also emphasise the emotional aspects of learning, which are important in engaging students in learning activities (Kahu, 2011). Students' interest has been found to be related to their perceptions of the design of teaching and learning activities and the relevance of the topic (Kember, Ho & Hong, 2010). In addition, interest has been shown to be positively related to effort, suggesting that students who are interested in a subject or task are more willing to invest time and effort in learning (Schiefele, 1991). Brophy (1998) argues that teachers should offer teaching and learning activities which students find meaningful and worthwhile, and that these will motivate them to learn and make them more willing to engage. It is clear that the students found the case seminar and the oral group assessment relevant and worthwhile, and that this seemed to have a positive

influence on their willingness to engage. What made these activities so interesting and meaningful?

One possible answer is that both activities included a dimension of perceived *authenticity*. Clinical cases were the point of departure for learning in both activities, and in the case seminar real human organs, obtained from surgical operations, were available for students to examine first hand. The process used for diagnosing the cases, beginning with patient histories and working towards a diagnosis, emulated the process the students would use as practising physicians. These activities were therefore highly relevant for their future profession, which is likely to have increased their interest and motivation (Kember et al., 2010). Furthermore, where the students in the present investigation used authentic patient cases with surgical specimens, or images of tissue and specimens, they were generally able to connect their theoretical knowledge of disease mechanisms to reality. This method provided concrete examples of the diseases they had learned about in their course books. Authenticity can be associated with clinical education where medical and healthcare students participate in real communities of practice in their profession (Wenger, 1998). However, authenticity can also be seen as learning experiences which are personally meaningful from the student's perspective, and at the same time relevant to the discipline and the profession in some way (Stein, Isaacs & Andrews, 2004; Tochon, 2000). In other words, a method which starts with a patient case, and gradually makes sense of the symptoms to arrive at a diagnosis, appears to be meaningful and relevant to both students and the medical community of practice. In this way, the case seminar and the group assessment can both be seen as authentic learning activities, which may be one reason why students appreciated them and were willing to engage in them.

In Study III, we explored the students' experiences of autopsies, which were conducted as routine procedure at the affiliated hospitals. These activities were authentic in the sense that students were participating in real autopsies performed by pathologists. Interestingly, although the students considered the autopsies to be an important aspect of medical education, only some students perceived them as authentic learning experiences. In fact, the strong negative emotions evoked by the experience seemed to alienate some students, and they did not learn much from the autopsies. The students were alienated in two ways: they either saw the body as an object, or they experienced a sense of absurdity and surrealism. In both cases, the students' attention was drawn by aspects other than the procedure of the autopsy. However, students who experienced the autopsies as a way of observing how pathologists work seemed to be interested and engaged in the activity, and found it meaningful for their learning. On a daily basis, practising physicians see patients whose illnesses vary in their seriousness, and they are very likely to have to witness some of these patients suffering and dying. From a professional perspective, therefore, the autopsy can be regarded as an authentic activity because it involves an encounter with a dead human being and a search for the cause of death. Students may experience a range of emotions in learning situations, such as anxiety, boredom, enjoyment, interest and pride (Pekrun, Goetz, Titz & Perry, 2002). Anatomical dissection and autopsies, which are still used in many medical schools, have been found to evoke extremely negative emotions, such as anxiety and disgust (Finkelstein & Mathers, 1990; McNamee et al., 2009; Penney, 1985). These emotions are

"forbidden" for professional medical practitioners, and there is evidence that medical students cope with their feelings either by focusing on specific body parts rather than on the body as a person, or by objectifying the body (Smith & Kleinman, 1989). In learning situations which evoke strong negative emotions, students primarily focus on managing their emotions, and learning comes second to coping. In order to overcome the alienation and make these activities worthwhile and personally meaningful, students are likely to need opportunities to discuss their experiences afterwards.

There were other indications of alienation in our findings. The vast amount of knowledge the students were supposed to acquire during the pathology course, and the many lectures which were packed full of information, made many students focus on coping with the heavy workload and "knowing the catalogue" rather than trying to develop a deeper understanding. The students felt frustrated by the information overload and lack of a bigger picture early in the course, which has also been noted with engineering students (Scheja, 2006). The activities offered at the beginning of the course did little to help students engage more deeply in the subject and discipline. Too much emphasis on theoretical knowledge, and lectures packed full of information, do not seem to motivate students, and can in fact be alienating (Bryson & Hand, 2007; Case, 2007; Kember et al., 2010).

DESIGNING FOR UNDERSTANDING

The overall design of the pathology course studied in this research focused first on general pathology, and basic processes of how cells react to damage and stress, which can lead to diseases in organs. This part was mainly taught through lectures and a few seminars, and ended with an individual, written, formative assessment. The students felt that it involved a great deal of new terminology, and that they had little time for independent study because of the long hours of lectures and seminars each day. Although the students seemed to like the lectures, they felt there were too many of them. They preferred the lectures where teachers provided an overview, explained new terminology or related the information to clinical cases. The formative assessment became an important external motivator, so that students began to study early in the course, which helped them to learn the basic terminology and acquire a sense of the road map of the course content (Study II). The second part of the course, focusing on organ-specific pathology, was taught through a greater variety of teaching and learning activities, such as case seminars with surgical specimens, autopsies, lectures and seminars with microscopic pictures. The students liked the variety and appreciated having more time for independent study. The organ-specific pathology was taught by different physicians, each an expert in his or her own field. Consequently, the students met some teachers only once or twice during the course. The course seemed to be a sort of "patchwork" of teaching and learning activities taught by different teachers, who may have had limited knowledge of the course as a whole, and who therefore focused on their own topic. This was clear from the fact that none of the teachers in the lectures observed during the research referred back to the general pathology taught in the first part of the course. The students were therefore not explicitly encouraged to relate the general principles and processes to the specific manifestations in different organs. The students themselves reflected that it was impossible to learn all the diseases they felt

they needed to know as practising physicians. They could only aim to learn as many of them as possible during the pathology course. This dilemma applies to all teaching; there is more to know than students can possibly learn during their education. Teachers and educators must make careful choices about where to focus. Several authors argue that teachers need to concentrate on important concepts, general models and "core principles", so that students learn them well and can use them to develop their understanding (Meyer & Land, 2005; Michael, Modell, McFarland & Cliff, 2009; Modell, 2000; Wiske, 1998). Perhaps this could have been done relatively easily by encouraging students to relate organ-specific pathology to general pathology, and to discern how critical features of general disease mechanisms are manifested in specific organs. This may help students to "learn how to learn" about diseases and their underlying mechanisms, a kind of *meta-knowledge* of what they need to know in preparation for their clinical years. There is evidence that a sound knowledge and deep understanding of the mechanisms of diseases, and their relationship to symptoms, is important in the diagnosis of difficult clinical cases (Woods et al., 2005, 2007a, 2007b).

A "structure-and-process" view of the curriculum, with an emphasis on content, appears to have influenced the overall design of the pathology course (Carraccio et al., 2002). Proponents of this view perceive teaching as "transmitting" the content, preferably through lectures, and the students' role is to acquire this information and assimilate it. Assessment is generally seen as "knowledge control" (Falchikov, 2005; Ramsden, 2003; Samuelowicz & Bain, 2002). Interestingly, however, the pathology course studied here was not based entirely on this view, and some of the TLAs involved different forms of teaching. The case seminar and the oral group assessment (Studies I and II), are examples of teaching as "making learning possible", and are designed to facilitate the development of understanding. The group assessment is seen as an opportunity to learn, and an integral part of teaching and learning (Falchikov, 2005; Sadler, 1989). These activities help students to develop their abilities and deepen their understanding, and are more in line with a competence view of the curriculum (Carraccio et al., 2002). In this respect, the pathology course was not congruent, and it is likely to have given students a variety of ways of acquiring the knowledge they needed. Furthermore, since the overall design of the course was based on the idea that the teachers should present the content, the work of integrating the knowledge into coherent wholes and developing a deeper understanding was left to the students. If the course is analysed within a teaching for understanding framework or from the point of view of constructive alignment, it is clear that it was not entirely constructively aligned, and that the intended learning outcomes (what the students should be able to know, understand and do at the end of the course) were not explicitly stated (Biggs & Tang, 2007; Wiske, 1998).

The pathology course was mainly teacher-centred, but included some TLAs which encouraged student activity, as discussed above. Student-centred and teacher-centred instruction need not be mutually exclusive, but can be seen rather as related dimensions of the teaching and learning environment (Elen, Clarebout, Léonard & Lowyck, 2007). Our findings suggest that students benefit from a learning environment which provides safe challenges to help them make interconnections and develop their understanding. The students in the study appreciated structure and clear information, a good balance between theory and practice and the opportunity to discuss with peers. Similar findings

were presented by Elen and colleagues (2007) who investigated students' perceptions of quality in higher education. Students felt that if courses were both teacher-centred and student-centred, they reinforced the learning environment. The authors argue that the levels of support offered by teachers should change gradually during a course, providing clear and well-structured information at the beginning, and then presenting students with challenging tasks and monitoring their learning. This gradual change from teacher-centred instruction to student-centred activities is also recommended by Baeten and co-workers (2012). They found that when case-based learning was gradually introduced, the students' use of surface approaches to learning decreased. Our findings suggest that the students' need for clear and well-structured information early in the course may be a response to their initial feeling of chaos, where there is no overview of the content and they are not clear about what they are expected to learn. However, this raise questions as to whether this clear support structure should be provided for students. It could be argued that they should engage in extracting meaning from the chaos, and need to develop their own structure in order to acquire a deep understanding of the material (Entwistle & Entwistle, 1992; Entwistle, 2009; Entwistle & Entwistle, 1991). Instead, it may be more important and beneficial to provide students with tools and opportunities for managing the initial chaos constructively. The sense of chaos and uncertainty about which material is relevant seems to be a recurrent phenomenon which students experience at the beginning of each new course. Students in a problem-based curriculum have been found to experience similar feelings of chaos and frustration (Silén, 2000). However, PBL curricula are designed to help them develop the necessary skills and abilities to become self-directed learners, able to develop their own structure in the perceived chaos. To facilitate this process, PBL curricula are based on small group sessions tutored by a teacher (Boud & Feletti, 1997). Other teaching and learning activities, such as lectures, are provided as resources for students, and can be designed to provide an overview of a subject or an in-depth example (Fyrenius et al., 2005). Drawing on the research presented here, it can be hypothesised that it is quite common for students to experience initial chaos and frustration, regardless of the discipline or type of curriculum. It may be difficult for teachers to understand this fully, and adapt to it, unless they interact with students and take their side of the story into account.

Looking at the pathology course from a perspective of "designing for understanding", two activities stand out as particularly interesting: the case seminar using surgical specimens and the oral group assessment. According to variation theory, learners need to discern the critical aspects of a phenomenon in order to understand it (Marton & Trigwell, 2000). Teaching and learning activities designed to facilitate understanding should therefore help students in this respect. One way of doing this may be to allow students to compare and analyse different cases, which is how the oral group assessment was conducted. One student explained that the oral group assessment had made her realise how she could diagnose diseases by comparing the symptoms described in the patient history to similar illnesses. She started to think in terms of differential diagnoses and began to discern the critical aspects a physician needs to consider in reaching a plausible diagnosis. Other TLAs, such as lectures and various types of seminar, were also helpful in the students' journey towards understanding, but they were more dependent on the teacher than on the design of the activity. The teachers' enthusiasm, and the extent to which they encouraged students to think for

themselves, were important aspects for learning, as well as the kind of questions they asked. In terms of their ability to facilitate understanding, some TLAs such as lectures, or seminars using microscopic images and autopsies, seemed to be more dependent on the individual teacher than TLAs like case seminars and oral group assessments.

Integrated curricula, where basic and clinical sciences are integrated horizontally or vertically, have become a standard approach in medical studies in the last decades (Harden, 2000a, 2000b). The way we teach influences students' learning and their development towards understanding. There is no doubt that learning theoretical knowledge in a real life context is beneficial for learning (Biggs & Tang, 2007; Boud & Feletti, 1997; Bransford et al., 2000; Norman & Schmidt, 1992). However, when we integrate several subjects and organise them around other principles such as themes or real life problems, the subject boundaries disintegrate. What happens, for instance, in integrated medical curricula where pathology is not learned as a subject in its own right but integrated with other subjects? Does the students' knowledge and understanding of pathology and disease mechanisms become fragmented? Are students then less likely to develop an integrated understanding of core principles and the "inner logic of pathology"? Is it important for physicians to have a sense of pathology as a subject, in terms of a framework for relating their knowledge of diseases? If so, how do different curricula influence their understanding of the underlying mechanisms and relationships between symptoms and disease? Furthermore, as anatomy dissection and autopsies are not part of medical curricula in many medical schools, what are the consequences for these students' understanding of the human body as a biological system? Our findings suggest that the visual and tactile experiences are important in developing understanding of the body as a whole. When students are denied first hand experience of the human body, how does this influence their understanding of how disease in one organ affects the body as a whole? There is currently insufficient evidence to address this issue fully, and this may be a subject for further investigation.

METHODOLOGICAL REFLECTIONS AND CONCLUSIONS

Baeten and co-workers (2010) have illustrated the lack of clarity about whether student-centred teaching, based on constructivist theories of learning, has a positive effect on student learning. Their research involved the use of inventories which measured students' perceptions of their overall course experiences. One explanation for the apparently contradictory findings may be that measuring students' perceptions on an overall course level is too broad a level of analysis. In fact, students may appreciate and benefit from all kinds of teaching and learning activities, including more traditional ones such as lectures and seminars (Elen et al., 2007). Our research design, observing teaching during a nine-week course and gathering data from students throughout the course, made it possible to discern a more nuanced picture of how teaching influences learning. Our findings suggest that the criterion which has the most impact is not the form of the activity, i.e. lecture or seminar, but rather how these activities are designed, the "scene" teachers set and what students are encouraged to do (Biggs, 1999; Ramsden, 2003; Selander, 2008). A lecture can be a monologue where a teacher presents a series of facts and details, or it can be an interactive session where students are invited to discuss, reflect on and extract meaning from the information they are

given. The same can be said of seminars. The design of TLAs is important. However, the pedagogical encounter between a teacher and students in the classroom is a complex interaction between teachers, students and content which can never be predicted or prescribed (Marton & Pang, 2006). Teaching and learning can, on the other hand, be described, and these descriptions can improve our understanding of the interactions between teaching and learning.

The interplay between teaching and learning is complex. The pathology course studied in the research project presented in this thesis seemed to be underpinned by contradictory epistemologies and perceptions of teaching and learning. On one hand, the overall course design appeared to be influenced by a concept of "teaching as telling" and assessment "as knowledge control". The students did not object to this view, but they were concerned about the long hours, as well as their passive role in many of the lectures and some of the seminars. On the other hand, they appreciated the activities where they had an active role and an opportunity to discuss and apply their knowledge. The course may have sent students different messages about what counts as knowledge in the course. However, they seemed to be pragmatic about it, and engaged in the learning activities regardless of the assumptions which underpinned them. Interestingly enough, this worked. The findings presented in this thesis suggest that students adapt, and seem to adjust their intentions and strategies to the demands of the specific learning environment they find themselves in. Consequently, the journey towards understanding may be more varied and complex than previous research has shown.

IMPLICATIONS FOR PRACTICE

From a practical point of view, the findings of this investigation reveal a pattern which seems to be important for students' development of understanding, and which could prove useful in designing teaching and learning activities in other settings. Both the case seminar and the oral group assessment seemed to be successful in facilitating students' understanding. From a design perspective, they shared a number of features. Both activities:

a) used real life cases as a point of departure;
b) focused on problem-solving and application of knowledge;
c) were student-centred and encouraged students to engage actively in their learning;
d) were based on collaborative learning in small groups;
e) allowed time for reflection and elaboration.

Taken as a whole, these features made these activities interesting and challenging, and gave a flavour of authenticity. Furthermore, the collaborative design created a safe environment where students could explore and elaborate their thinking with peers. The common features described above are also characteristic of problem-based learning (Boud & Feletti, 1997). However, in problem-based curricula the entire curriculum is designed around small group learning, which is a radical departure from a conventional, discipline-based curriculum. Our findings point to the possibility of facilitating learning with relatively few resources. Designing a traditional lecture-based course to include a

series of well thought-out, student-centred activities may go a long way to helping students develop a deeper understanding. Formative assessment is an important tool for learning as it motivates students to study, and gives both teachers and students feedback on learning (Black & Wiliam, 1998; Sadler, 1989). Furthermore, formative assessment influences students' learning, and should be an integral part of a course, but should focus on facilitating understanding and not just assessing factual knowledge. Assessment tasks which require problem-solving, analysis, elaboration and collaboration seem to stimulate the development of understanding.

From a course design perspective, our findings also suggest that it is wise to offer a variety of teaching and learning activities throughout a course, by alternating lectures and seminars, small group activities and formative assessments. In addition, the features described above (a-e) may be used as a guideline, regardless of the type of TLA. Furthermore, students need time for independent study, and from a learning perspective, too many long days of scheduled class time may be counterproductive.

Medical and healthcare students may find themselves in learning situations which evoke strong, negative emotions. One example is an autopsy. Students are likely to need opportunities to talk about and discuss their experiences in a safe environment. The experience can trigger existential issues and thoughts about death and dignity, and can raise questions about how to empathise with patients and their relatives while maintaining a professional attitude. Students will face these issues as practising physicians, and it is therefore important to prepare them for managing their emotions in situations like this.

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9 REFERENCES

Ahopelto, I., Mikkilä-Erdmann, M., Olkinuora, E., & Kääpä, P. (2011). A follow-up study of medical students' biomedical understanding and clinical reasoning concerning the cardiovascular system. *Advances in Health Sciences Education*, 1-14.

Albert, M., Hodges, B. D., & Regehr, G. (2007). Research in medical education: balancing service and science. *Advances in Health Sciences Education, 12*(1), 103-115.

Anderson, C., & Hounsell, D. (2007). Knowledge practices: 'doing the subject' in undergraduate courses. *The Curriculum Journal, 18*(4), 463-478.

Aspers, P. (2007). *Etnografiska metoder: att förstå och förklara samtiden*. Malmö: Liber.

Asplund, J. (1970). *Om undran inför samhället*. Lund: Argos.

Auble, P. M., Franks, J. J., & Soraci, S. A. (1979). Effort toward comprehension: Elaboration or "aha!"? *Memory & Cognition, 7*(6), 426-434.

Ausubel, D. P., Novak, J. D., & Hanesian, H. (1968). *Educational Psychology: A cognitive view* (2nd ed.). New York: Holt, Rinehart and Winston.

Baeten, M., Dochy, F., & Struyven, K. (2012). Enhancing students' approaches to learning: the added value of gradually implementing case-based learning. *European Journal of Psychology of Education, Online First*, 1-22.

Baeten, M., Kyndt, E., Struyven, K., & Dochy, F. (2010). Using student-centred learning environments to stimulate deep approaches to learning: Factors encouraging or discouraging their effectiveness. *Educational Research Review, 5*(3), 243-260.

Barnett, R. (2007). *A will to learn: Being a student in an age of uncertainty*. Maidenhead, Birkshire: Open University Press.

Barrows, H. S., & Tamblyn, R. M. (1980). *Problem-based learning: An approach to medical education*. New York: Springer.

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher Education, 32*(3), 347-364.

Biggs, J. (1999). What the Student Does: teaching for enhanced learning. *Higher Education Research & Development, 18*(1), 57-75.

Biggs, J., & Tang, C. (2007). *Teaching for quality learning at university* (3 ed.). Maidenhead: SRHE & Open University Press.

Billett, S. (1996). Situated learning: Bridging sociocultural and cognitive theorising. *Learning and Instruction, 6*(3), 263-280.

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education, 5*(1), 7-74.

Bligh, J., & Brice, J. (2008). What is the value of good medical education research? *Medical Education, 42*(7), 652-653.

Bolander Laksov, K., Lonka, K., & Josephson, A. (2008). How do medical teachers address the problem of transfer? *Advances in Health Sciences Education, 13*(3), 345-360.

Bordage, G. (2009). Conceptual frameworks to illuminate and magnify. *Medical Education, 43*(4), 312-319.

Boud, D., & Feletti, G. (Eds.). (1997). *The challenge of problem-based learning* (2 ed.). London: Kogan Page.

Bowden, J., & Marton, F. (1998). *The university of learning: Beyond quality and competence*. London: RoutledgeFalmer.

Boyatzis, R. E. (1998). *Transforming Qualitative Information: Thematic analysis and code development*. Thousand Oaks, CA: SAGE Publications.

Bransford, J. D., Brown, A.L. & Cocking, R.R. (Eds) (2000). *How People Learn: Brain, Mind, Experience and School.*: National Academy Press, Washington, DC.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101.

Brophy, J. (1998). *Motivating students to learn*. Boston, Massachusetts: McGraw-Hill.

Bruner, J. S. (1977). *The process of education*. Cambridge, MA: Harvard University Press.

Bryson, C., & Hand, L. (2007). The role of engagement in inspiring teaching and learning. *Innovations in Education and Teaching International, 44*(4), 349-362.

Bunniss, S., & Kelly, D. R. (2010). Research paradigms in medical education research. *Medical Education, 44*(4), 358-366.

Burns, J., Clift, J., & Duncan, J. (1991). Understanding of Understanding: Implications for learning and teaching. *British Journal of Educational Psychology, 61*(3), 276-289.

Caelli, K., Ray, L., & Mill, J. (2003). 'Clear as Mud': Toward Greater Clarity in Generic Qualitative Research. *International Journal of Qualitative Methods, 2*(2), 1-13.

Carraccio, C., Wolfsthal, S. D., Englander, R., Ferentz, K., & Martin, C. (2002). Shifting Paradigms: From Flexner to Competencies. *Academic Medicine, 77*(5), 361-367.

Case, J. M. (2007). Alientation and engagement: exploring students' experiences of studying engineering. *Teaching in Higher Education, 12*(1), 119-133.

Case, J. M. (2008). Alienation and engagement: development of an alternative theoretical framework for understanding student learning. *Higher Education, 55*(3), 321-332.

Cavanagh, S. (1997). Content analysis: concepts, methods and application. *Nurse Researcher, 4*(3), 5-16.

Charmaz, K. (2006). *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. London: SAGE Publications.

Cook, D. A., Bordage, G., & Schmidt, H. G. (2008). Description, justification and clarification: a framework for classifying the purposes of research in medical education. *Medical Education, 42*(2), 128-133.

Denzin, N. K., & Lincoln, Y. S. (2003). *Collecting and Interpreting Qualitative Materials* (2nd ed.). Thousand Oaks, CA: SAGE Publications.

Dillenbourgh, P. (1999). What do you mean by collaborative learning? In P. Dillenbourgh (Ed.), *Collaborative Learning: Cognitive and Computational Approaches.* (pp. 1-19.). Oxford: Elsevier.

Dolmans, D. H. J. M., & Schmidt, H. G. (2006). What Do We Know About Cognitive Motivational Effects of Small Group Tutorials in Problem-Based Learning? *Advances in Health Sciences Education, 11*, 321-336.

Elen, J., Clarebout, G., Léonard, R., & Lowyck, J. (2007). Student-centred and teacher-centred learning environments: What students think. *Teaching in Higher Education, 12*(1), 105-117.

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing, 62*(1), 107-115.

Entwistle, A., & Entwistle, N. (1992). Experiences of understanding in revising for degree examinations. *Learning and Instruction, 2*(1), 1-22.

Entwistle, N. (1995). Frameworks for Understanding as Experienced in Essay Writing and in Preparing for Examinations. *Educational Psychologist, 30*, 47-54.

Entwistle, N. (2009). *Teaching for Understanding at University: Deep Approaches and Distinctive Ways of Thinking*. New York: Palgrave Macmillan.

Entwistle, N., & Entwistle, D. (2003). Preparing for Examinations: The interplay of memorising and understanding, and the development of knowledge objects. *Higher Education Research & Development, 22*(1), 19-41.

Entwistle, N., & Marton, F. (1994). Knowledge objects: understandings constituted through intensive academic study. *British Journal of Educational Psychology, 64*(1), 161-178.

Entwistle, N., & Ramsden, P. (1983). *Understanding student learning*. London: Croom Helm Ltd.

Entwistle, N., & Smith, C. (2002). Personal understanding and target understanding: Mapping influences on the outcomes of learning. *British Journal of Educational Psychology, 72*(3), 321-342.

Entwistle, N. J., & Entwistle, A. (1991). Contrasting forms of understanding for degree examinations: the student experience and its implications. *Higher Education, 22*(3), 205-227.

Entwistle, N. J., & Peterson, E. R. (2004). Conceptions of learning and knowledge in higher education: Relationships with study behaviour and influences of learning environments. *International Journal of Educational Research, 41*, 407-428.

Falchikov, N. (2005). *Improving Assessment Through Student Involvement: Practical solutions for aiding learning in higher and further education*. New York: Routledge.

Finkelstein, P., & Mathers, L. (1990). Post-traumatic stress among medical students in the anatomy dissection laboratory. *Clinical Anatomy, 3*(3), 219-226.

Fosnot, C. T. (1996). Constructivism: A psychological theory of learning. In C. T. Fosnot (Ed.), *Constructivism: Theory, Perspectives ans Practice* (pp. 8-33). New York: Teachers College Press, Columbia University.

Fyrenius, A. (2006). *Dynamiskt lärande: En ämnesdidaktisk avhandling om fysiologiska fenomen och läkarstudenters lärande.* Linköping University, Linköping. Thesis for Doctoral degree.

Fyrenius, A., Bergdahl, B. & Silén, C. (2005). Lectures in problem-based learning - Why, when and how? An example of interactive lecturing that stimulates meaningful learning. *Medical Teacher, 27*, 61 - 65.

Fyrenius, A., Silen, C., & Wirell, S. (2007). Students' conceptions of underlying principles in medical physiology: an interview study of medical students' understanding in a PBL curriculum. *Advances in Physiology Education, 31*(4), 364-369.

Fyrenius, A., Wirell, S., & Silén, C. (2007). Student approaches to achieving understanding - approaches to learning revisited. *Studies in Higher Education, 32*(2), 149-165.

Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts, procedures and measures to achieve trustworthiness. *Nurse Education Today, 24*(2), 105-112.

Gustavsson, A. (2000). *Tolkning och tolkningsteori 1 – introduktion.* Stockholm: Pedagogiska institutionen, Stockholms universitet.

Gärdenfors, P. (2010). *Lusten att förstå: Om lärande på människans villkor.* Stockholm: Natur & Kultur.

Haidet, P., O'Malley K.J. & Richards, B. . (2002). An Initial Experience with "Team Learning" in Medical Education. *Academic Medicine, 70*, 40-44.

Harden, R. M. (2000a). Evolution or revolution and the future of medical education: replacing the oak tree. *Medical Teacher, 22*, 435-442.

Harden, R. M. (2000b). The integration ladder: a tool for curriculum planning and evaluation. *Medical Education, 34*(7), 551-557.

Harden, R. M., Crosby, J. R., & Davis, M. H. (1999). AMEE Guide No 14: Outcome-based education: Part 1 - An introduction to outcome-based education. *Medical Teacher, 21*(1), 7-14.

Harden, R. M., & Stamper, N. (1999). What is a spiral curriculum? *Medical Teacher, 21*(2), 141-144.

Hattie, J., & Jaeger, R. (1998). Assessment and classroom learning: A deductive approach. *Assessment in Education, 5*(1), 111-122.

Hindmarsh, J. (2007). *Embodying understanding: Training and the body in clinical situations*. Paper presented at the Earli Conference.

Holloway, I., & Todres, L. (2003). The Status of Method: Flexibility, Consistency and Coherence. *Qualitative Research, 3*(3), 345-357.

Hounsell, D. (2007). Towards more sustainable feedback to students. In D. Boud & N. Falchikov (Eds.), *Rethinking Assessment in Higher Education: Learning for the longer term* (pp. 101-113). London: Routledge.

Hsieh, H.-F., & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research, 15*(9), 1277-1288.

Jarvis, P. (2006). *Towards a comprehensive theory of human learning*. London: Routledge.

Jolly, B. (1998). Charting the course: designing a medical curriculum. In B. Jolly & L. Rees (Eds.), *Medical education in the millenium* (pp. 21-41). Oxford: Oxford University Press.

Kahu, E. R. (2011). Framing student engagement in higher education. *Studies in Higher Education, iFirst*, 1-16.

Kaufman, D. R., Keselman, A., & Patel, V. L. (2008). Changing conceptions in medicine and health. In S. Vosniadou (Ed.), *International Handbook of Research on Conceptual Change* (pp. 295-327). New York: Routledge.

Kember, D. (1996). The intention to both memorise and understand: Another approach to learning? *Higher Education, 31*(3), 341-354.

Kember, D., Ho, A., & Hong, C. (2010). Characterising a teaching and learning environment capable of motivating student learning. *Learning Environments Research, 13*(1), 43-57.

Koch, T. (1994). Establishing rigour in qualitative research: the decision trail. *Journal of Advanced Nursing, 19*(5), 976-986.

Koch, T., & Harrington, A. (1998). Reconceptualizing rigour: the case for reflexivity. *Journal of Advanced Nursing, 28*(4), 882-890.

Koles, P., Nelson, S., Stolfi, A., Parmelee, D. & Destephen, D. . (2005). Active Learning in a Year 2 pathology curriculum. . *Medical Education, 39*, 1045-1055.

Kreber, C. (Ed.). (2009). *The university and its disciplines: Teaching and learning within and beyond disciplinary boundaries*. New York: Routledge.

Kuper, A., Lingard, L., & Levinson, W. (2008). Critically appraising qualitative research. *BMJ, 337*(aug07_3), a1035-.

Larsson, S. (2009). A pluralist view of generalization in qualitative research. *International Journal of Research & Method in Education, 32*(1), 25-38.

Leach, J., & Scott, P. (2003). Individual and Sociocultural Views of Learning in Science Education. *Science & Education, 12*, 91-113.

Lincoln, Y. S., & Guba, E. G. (2003). Paradigmatic Controversies, Contradictions, and Emerging Confluences. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Landscape of Qualitative Research: Theories and Issues* (2nd ed., pp. 253-291). Thousand Oaks, CA: SAGE Publications.

Lindblom-Ylänne, S., & Lonka, K. (1999). Individual ways of interacting with the learning environment - are they related to study success? *Learning and Instruction, 9*, 1-18.

Lindblom-Ylänne, S., Trigwell, K., Nevgi, A., & Ashwin, P. (2006). How approaches to teaching are affected by discipline and teaching context. *Studies in Higher Education, 31*(3), 285-298.

Lizzio, A., Wilson, K. & Simons, R. . (2002). University students' perceptions of the learning environment and academic outcomes: implications for theory and practice. *Studies in Higher Education, 27*, 27-52.

Lonka, K., & Lindblom-Ylänne, S. (1996). Epistemologies, conceptions of learning, and study practices in medicine and psychology. *Higher Education, 31*, 5-24.

Mann, S. J. (2001). Alternative Perspectives on the Student Experience: Alienation and engagement. *Studies in Higher Education, 26*(1), 7-19.

Martin, E., Prosser, M., Trigwell, K., Ramsden, P., & Benjamin, J. (2000). What university teachers teach and how they teach it. *Instructional Science, 28*(5), 387-412.

Marton, F., Beaty, E., & Dall' Alba, G. (1993). Conceptions of learning. *International Journal of Educational Research, 19*(2), 277-300.

Marton, F., & Booth, S. (1997). *Om lärande*. Lund: Studentlitteratur.

Marton, F., Hounsell, D., & Entwistle, N. (Eds.). (1997). *The Experience of Learning: Implications for teaching and studying in higher education. *. Edinburgh: Scottish Academic Press.

Marton, F., & Pang, M. F. (2006). On Some Necessary Conditions of Learning. *Journal of the Learning Sciences, 15*(2), 193 - 220.

Marton, F., & Säljö, R. (1976a). On qualitative differences in learning: I - Outcome and process. *British Journal of Educational Psychology, 46*, 4-11.

Marton, F., & Säljö, R. (1976b). On qualitative differences in learning: II - Outcome as a function of the learner's conception of the task. *British Journal of Educational Psychology, 46*, 115-127.

Marton, F., & Säljö, R. (1997). Approaches to learning. In F. Marton, D. Hounsell & N. Entwistle (Eds.), *The experience of learning. Implications for teaching and studying in higher education* (pp. 39-59). Edinburgh: Scottish Academic Press.

Marton, F., & Trigwell, K. (2000). Variatio Est Mater Studiorum. *Higher Education Research and Development, 19*(3), 381 - 395.

Marton, F., Wen, Q., & Wong, K. C. (2005). 'Read a hundred times and the meaning will appear ...' Changes in Chinese University students' views of the temporal structure of learning. *Higher Education, 49*(3), 291-318.

Mattick, K. K., L. . (2007). High-quality learning: harder to achieve than we think? . *Medical Education, 41*, 638-644.

McCune, V. (2009). Final year biosciences students' willingness to engage: teaching-learning environments, authentic learning experiences and identities. *Studies in Higher Education, 34*(3), 347 - 361.

McCune, V., & Hounsell, D. (2005). The development of students' ways of thinking and practising in three final-year biology courses. *Higher Education, 49*(3), 255-289.

McNamee, L. S., O'Brien, F. Y., & Botha, J. H. (2009). Student perceptions of medico-legal autopsy demonstrations in a student-centred curriculum. *Medical Education, 43*(1), 66-73.

Meyer, J. H. F., & Land, R. (2005). Threshold concepts and troublesome knowledge (2): Epistemological considerations and a conceptual framework for teaching and learning. *Higher Education, 49*(3), 373-388.

Michael, J., Modell, H., McFarland, J., & Cliff, W. (2009). The "core principles" of physiology: what should students understand? *Advances in Physiology Education, 33*(1), 10-16.

Michael, J. A. (1998). Students' misconceptions about perceived physiological responses. *Advances in Physiology Education, 274*(6), S90-S98.

Modell, H. I. (2000). How to help students understand physiology? Emphasize general models. *Advances in Physiology Education, 23*(1), 101-107.

Modell, H. I., Michael, J. A., Adamson, T., & Horwitz, B. (2004). Enhancing active learning in the student laboratory. *Advances in Physiology Education, 28*(3), 107-111.

Monrouxe, L. V., & Rees, C. E. (2009). Picking up the gauntlet: constructing medical education as a social science. *Medical Education, 43*(3), 196-198.

Neuendorf, K. (2002). *The Content Analysis Guidebook*. Thousand Oaks: Sage Publications.

Newble, D. I., & Clarke, R. M. (1986). The approaches to learning of students in a traditional and in an innovative problem-based medical school. *Medical Education, 20*(4), 267-273.

Newton, D. P. (1999). Knowing what Counts as Understanding in Different Disciplines: Some 10-year-old children's conceptions. *Educational Studies, 25*(1), 35-54.

Newton, D. P. (2000). *Teaching for Understanding: What It Is and How To Do It*. London: Routledge Falmer.

Newton, D. P., Newton, L. D., & Oberski, I. (1998). Learning and Conceptions of Understanding in History and Science: lecturers and new graduates compared. *Studies in Higher Education, 23*(1), 43-58.

Nickerson, R. S. (1985). Understanding understanding. *American Journal of Education, 93*(2), 201-239.

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. *Studies in Higher Education, 31*(2), 199 - 218.

Nielsen, D., Gotzsche, O., Sonne, O., & Eika, B. (2012). The relationship between immediate relevant basic science knowledge and clinical knowledge: physiology knowledge and transthoracic echocardiography image interpretation. *Advances in Health Sciences Education, OnlineFirst*, 1-13.

Norman, G. R., & Schmidt, H. G. (1992). The psychological basis of problem-based learning: a review of the evidence. *Academic Medicine, 67*(9), 557-565.

Packer, M. J., & Goicoechea, J. (2000). Sociocultural and constructivist theories of learning: Ontology, not just epistemology. *Educational Psychologist, 35*(4), 227-241.

Pandey, P., & Zimitat, C. (2007). Medical students' learning of anatomy: memorisation, understanding and visualisation. *Medical Education, 41*(1), 7-14.

Patton, M. Q. (2002). *Qualitative Research & Evaluation Methods* (3rd Edition ed.). Thousand Oaks: SAGE Publications.

Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic Emotions in Students' Self-Regulated Learning and Achievement: A Program of Qualitative and Quantitative Research. *Educational Psychologist, 37*(2), 91-105.

Penney, J. C. (1985). Reactions of Medical Students to Dissection. *Journal of Medical Education, 60*(1), 58-60.

Perkins, D. (1998). What Is Understanding? In M. S. Wiske (Ed.), *Teaching for Understanding: Linking Research with Practice* (pp. 39-57). San Fransisco: Jossey-Bass.

Perkins, D. (1999). The many faces of constructivism. *Educational Leadership, Nov*, 6-11.

Pintrich, P. R. (2003). A motivational science perspective on the role of studnet motivation in learning and teaching contexts. *Journal of Educational Psychology, 95*(4), 667-686.

Prosser, M., Martin, E., Trigwell, K., Ramsden, P., & Lueckenhausen, G. (2005). Academics' experiences of understanding of their subject matter and the relationship of this to their experiences of teaching and learning. *Instructional Science, 33*(2), 137-157.

Ramsden, P. (2003). *Learning to teach in higher education* (2nd ed.). London: RoutledgeFalmer.

Rolfe, G. (2006). Validity, trustworthiness and rigour: quality and the idea of qualitative research. *Journal of Advanced Nursing, 53*(3), 304-310.

Ross, M. T., & Stenfors-Hayes, T. (2008). Development of a framework of medical undergraduate teaching activities. *Medical Education, 42*(9), 915-922.

Sadler, D. R. (1989). Formative assessment and the design of instructional systems. *Instructional Science, 18*, 119-144.

Samuelowicz, K., & Bain, J. (2002). Identifying academics' orientations to assessment practice. *Higher Education, 43*(2), 173-201.

Scheja, M. (2006). Delayed Understanding and Staying in Phase: Students' Perceptions of their Study Situation. *Higher Education, 52*(3), 421-445.

Scheja, M., & Bonnevier, A. (2010). Conceptualising students' experiences of understanding in medicine. *The Journal of the Hellenic Psychological Society, 17*(3), 243-258.

Schiefele, U. (1991). Interest, learning and motivation. *Educational Psychologist, 26*, 299-323.

Schmidt, H. G., & Rikers, R. M. J. P. (2007). How expertise develops in medicine: knowledge encapsulation and illness script formation. *Medical Education, 41*(12), 1133-1139.

Schunk, D. H. (2004). Constructivism. In D. H. Schunk (Ed.), *Learning Theories: An Educational Perspective* (Fourth ed., pp. 285-328). Upper Saddle River, New Jersey: Pearson.

Selander, S. (2008). Designs for learning - A theoretical perspective. *Designs for Learning, 1*(1), 10-22.

Selwyn, N., & Robson, K. (1998). Using e-mail as a research tool. *Social Research Update*(21).

Sfard, A. (1998). On Two Metaphors for Learning and the Dangers of Choosing Just One. *Educational Researcher, 27*(2), 4-23.

Sfard, A. (2002, June). *Acquisitionist misunderstandings about understanding: What new conceptualizations of learning have to say about learning-with-understanding.* Paper presented at the Proceedings of the Workshop on Mathematical Understanding Turku, Finland.

Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information, 22*, 63-75.

Shuell, T. J. (1990). Phases of meaningful learning. *Review of Educational Research, 60*(4), 531-547.

Shulman, L. S. (2005). Signature pedagogies in the professions. *Daedalus, 134*(3), 52-59.

Silén, C. (2000). *Mellan kaos och kosmos - om eget ansvar och självständighet i lärande.* Linköpings universitet, Department of Behavioral Sciences, Linköping. Thesis for Doctoral degree.

Silverman, D. (2006). *Interpreting qualitative data* (3 ed.). Thousand Oaks: Sage Publications.

Smith, A. C., & Kleinman, S. (1989). Managing Emotions in Medical School: Students' Contacts with the Living and the Dead. *Social Psychology Quarterly, 52*(1), 56-69.

Smith, J., Bekker, H., & Cheater, F. (2011). Theoretical versus pragmatic design in qualitative research. *Nurse Researcher, 18*(2), 39-51.

Snyder, B. R. (1971). *The Hidden Curriculum.* Cambridge, MA: MIT Press.

Stein, S. J., Isaacs, G., & Andrews, T. (2004). Incorporating authentic learning experiences within a university course. *Studies in Higher Education, 29*(2), 239-258.

Steinert, Y. S., L. . (1999). Interactive lecturing: strategies for increasing participation in large group presentations. *Medical Teacher, 19*, 37-42.

Stjernquist, M. (2001). Casemetodik - ny studentaktiv pedagogik i läkarutbildningen. *Läkartidningen 98*, 174-176.

Struyven, K., Dochy, F., Janssens, S., & Gielen, S. (2006). On the dynamics of students' approaches to learning: The effects of the teaching/learning environment. *Learning and Instruction, 16*(4), 279-294.

Svensson, L. (1997). Skill in learning and organising knowledge. In F. Marton, D. Hounsell & N. Entwistle (Eds.), *The experience of learning. Implications for teaching and studying in higher education* (pp. 59-71). Edinburgh: Scottish Academic Press.

Säljö, R. (1979). *Learning in the learner's perspective I. Some common sense conceptions*: University of Gothenburgh.

Thurmond, V. A. (2001). The Point of Triangulation. *Journal of Nursing Scholarship, 33*(3), 253-258.

Tochon, F. V. (2000). When authentic experiences are "enminded" into disciplinary genres: crossing biographic and situated knowledge. *Learning and Instruction, 10*(4), 331-359.

Tosteson, D. C. (1990). New Pathways in General Medical Education. *New England Journal of Medicine, 322*(4), 234-238.

Trigwell, K., & Prosser, M. (1991). Improving the quality of student learning: the influence of learning context and student approaches to learning on learning outcomes. *Higher Education, 22*(3), 251-266.

Trigwell, K., & Prosser, M. (1997). Towards an Understanding of Individual Acts of Teaching and Learning. *Higher Education Research & Development, 16*(2), 241-252.

Tärnvik, A. (2004). Case-metodik - undervisningsform som engagerar *Läkartidningen 101*, 3314-3319.

Van Rossum, E. J., & Schenk, S. M. (1984). The realationship between learning conception, study strategy and learning outcome. *British Journal of Educational Psychology, 54*(1), 73-83.

Wenger, E. (1998). *Communities of practice: Learning, meaning and identity.* New York: Cambridge University Press.

Vermunt, J. D., & Verloop, N. (1999). Congruence and friction between learning and teaching. *Learning and Instruction, 9*(3), 257-280.

Vermunt, J. D., & Vermetteren, Y. J. (2004). Patterns in student learning: relationships between learning strategies, conceptions of learning and learning orientations. *Educational Psychology Review, 16*, 359-384.

Wierstra, R. F. A., Kanselaar, G., van der Linden, J. L., Lodewijks, H. G. L. C., & Vermunt, J. D. (2003). The impact of the university context on European students' learning approaches and learning environment preferences. *Higher Education, 45*(4), 503-523.

Wilhelmsson, N. (2010). *From basic science knowledge to clinical understanding.* Karolinska Institutet, Stockholm. Thesis for Doctoral degree.

Wilhelmsson, N., Dahlgren, L. O., Hult, H., & Josephson, A. (2011). On the anatomy of understanding. *Studies in Higher Education, 36*(2), 153-165.

Wilhelmsson, N., Dahlgren, L. O., Hult, H., Scheja, M., Lonka, K., & Josephson, A. (2010). The anatomy of learning anatomy. *Advances in Health Sciences Education, 15*(2), 153-165.

Wills, T., Estow, S., Soraci, S. A., & Garcia, J. (2006). The Aha Effect in Groups and Other Dynamic Learning Contexts. *The Journal of General Psychology, 133*(3), 221-236.

Wilson, K., & Fowler, J. (2005). Assessing the impact of learning environments on students' approaches to learning: comparing conventional and action learning designs. *Assessment and Evaluation in Higher Education, 30*(1), 87 - 101.

Wiske, M. S. (Ed.). (1998). *Teaching for understanding: Linking research with practice*. San Francicso: Jossey-Bass.

Woods, N. N., Brooks, L.R. & Norman, G.R. (2005). The value of basic science in clinical diagnosis: creating coherence among signs and symptoms. *Medical Education, 39*, 107-112.

Woods, N. N., Brooks, L.R. & Norman, G.R. (2007a). It all makes sense: biomedical knowledge, causal connections and memory in the novice diagnostician. *Advances in Health Science Education, 12*, 405-415.

Woods, N. N., Brooks, L.R. & Norman, G.R. (2007b). The role of biomedical knowledge in diagnosis of difficult clinical cases. *Advances in Health Science Education, 12*, 417-426.

Vosniadou, S. (Ed.). (2008). *International Handbook of Research on Conceptual Change*. New York: Routledge.

Vosniadou, S., Vamvakoussi, X., & Skopeliti, I. (2008). The framework theory approach to the problem of conceptual change. In S. Vosniadou (Ed.), *International Handbook of Research on Conceptual Change* (pp. 3-34). New York: Routledge.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge: Harvard University Press.