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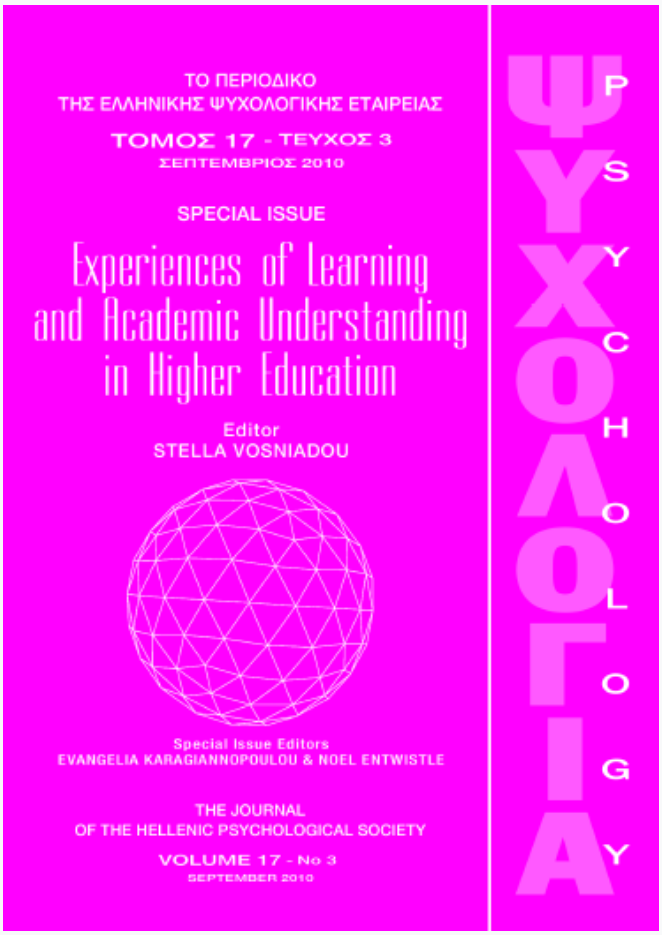

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Conceptualising students' experiences of understanding in medicine

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ABSTRACT This paper draws on ongoing work into student learning in higher education to consider a basis for conceptualising students' experiences of understanding in medicine. Starting with a modest overview of research on the nature of students' experiences of understanding the paper goes on to consider research on students' personal understandings in terms of knowledge objects. Linking on to research on students' epistemological beliefs the paper forges connections to recent research on threshold concepts and related research on conceptual change. Against the background of this brief overview the paper surveys the research on medical education, and then draws on interview data, currently being collected in a Swedish research project, to offer a preliminary conceptualisation of students' experiences of understanding in medicine.

Key words: Interviews, Students' experiences of understanding, Higher education, Medical education.

1. Introduction

"The structure of the programme is that it continually adds on. First term it's the structure and function of the cell... that course is pretty difficult and boring. You have to get through it. Then you realise, as the terms pass, that it was probably quite a good idea to take that course, because everything keeps coming back and you tend to grasp things afterwards. You somehow manage to bring the picture together [---] as you put the courses behind you, everything gradually falls into place and you're able to connect the molecules with diseases and medicines, yeah everything is being linked together".

The quote above – taken from an interview with an undergraduate student at a large Swedish medical university – is interesting in several ways. Apart from providing an illustration of an individual student's overall experience of developing understanding in relation to medical

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studies ("*you tend to grasp things afterwards*", "*everything gradually falls into place*"), the quote also says something about the student's experience of the process through which this understanding is brought about ("*manage to bring the picture together*", "*you're able to connect the molecules with diseases and medicines*", "*everything is being linked together*"). Such accounts, of learning material being integrated and pieces of information being put in place seem to be quite typical of students' experiences of having understood something. But what do we really know about the processes that lead to such experiences of understanding?

The very existence of this special issue suggests that we do not know enough, neither about the nature of students' experiences of understanding, nor the process through which such experiences are produced. This is of course not to say that research on students' experiences of understanding does not exist. It does, and this paper will begin by sketching the contours of some of this research. Starting with a presentation of research on the nature of students' experiences of understanding, the paper goes on to consider research on students' manifest personal understandings in terms of "knowledge objects".

The paper then widens its focus to describe basic research on students' general conceptions of knowledge and learning. Reflecting on the context-dependency of learning, the paper then makes a connection to more recent research into "threshold concepts" which addresses important transformative and integrative aspects of understanding. The focus on transformation and integration of concepts also encourages links to be made to related research on conceptual change, focusing on concept formation and meaning making. In light of this general overview of research of relevance to students' experiences of understanding, the paper will go on to consider research into the specific setting of medical education. Drawing on interview data currently being collected in a Swedish research project investigating students' development of understanding in medicine and engineering, the paper concludes with a discussion of emerging findings on students' experiences of understanding in medicine.

2. Review of studies on student understanding in general

Research on forms and experiences of understanding

While thirty years ago research on the nature of understanding in higher education was hard to find, the last two decades have seen a much more lively interest in this topic. A series of studies carried out in Britain in the 1990s have been particularly helpful in describing the form and structure of students' experiences of understanding as this understanding is being developed in relation to studies in higher education. For instance, Entwistle and Entwistle (1992) carried out extensive phenomenographic interviews with British students who were preparing for their final exams. Students were encouraged to talk in detail about the way in which they went about grasping central topics in the subjects studied and, from the students' accounts, Entwistle and Entwistle (1992) were able to describe five distinct forms of understanding developed during revision (Table 1).

Subsequent research went on to explore in greater detail students' experiences of achieving or, as the case may be, of failing to achieve understanding of topics studied. While typical experiences of understanding involved feelings of satisfaction, connectedness and coherence, experiences of failure to understand typically involved feelings of confusion, disconnectedness and incoherence.

Understandings as knowledge objects

These findings, while interesting in themselves, have had the important role of stimulating further research into students' experiences of understanding with a particular focus on how such understanding can be conceptualised from a student perspective. Delving deeper into the interview data collected by Entwistle and Entwistle (1992), Entwistle and Marton (1994) found that coming to understand particular concepts or aspects of a subject can sometimes involve the development of *knowledge objects*. In particular, Entwistle and Marton (1994)

Table 1
Forms of understanding developed during revision
(adapted from Entwistle & Marton, 1994, p. 163)

Category	Description
A.	Absorbing facts, details, and procedures related to exams without consideration of structure.
B.	Accepting and using only the knowledge and logical structures provided in the lecture notes.
C.	Relying mainly on notes to develop summary structures solely to control exam answers.
D.	Developing structures from strategic reading to represent personal understanding, but also to control exam answers.
E.	Developing structures from wide reading which relate personal understanding to the nature of the discipline.

found that hard-working students who find themselves in a situation requiring of them to demonstrate their understandings, for instance in preparing for exams or in dealing with particularly demanding learning tasks, sometimes experience their understandings in terms of individual and highly flexible structures in their minds. Such "knowledge objects" appear to be perceived as almost visual entities that can be used as mnemonic tools to structure thinking and to tailor explanations to meet requirements of, for instance, specific exam questions (Entwistle & Marton, 1994; see also Entwistle, 1995; Entwistle & Entwistle, 2003; Entwistle & Entwistle, 2005). Although the term knowledge object might give the impression of a closed and fixed form of understanding that can be readily transferred from one setting to another, this notion actually refers to a highly flexible and contextualised understanding that students may only develop through intensive academic study (Entwistle, 2007).

The research on forms of understanding and knowledge objects was predominantly based on data collected in subject areas where concepts were clearly defined, and where the experiences of understanding described by students typically came from grasping the interrelations among concepts and groups of concepts, and from recognizing how existing evidence could be used to substantiate the understandings reached. However, reflecting on the value of research on learning in general it is important to bear in mind that learning is a highly situated phenomenon (Resnick, 1989) that has to be understood in relation to the specific learning environment in which it occurs. While this recognition of the context-dependency of learning has been around since the 1980's in research on student learning in higher education, it is not until relatively recently that researchers have managed to document the extent to which learning is actually bounded by the specific ways of thinking and practising endorsed within a particular discipline or educational programme (e.g. Entwistle, Nisbet, & Bromage, 2005; McCune & Hounsell, 2005).

Developing understanding within an academic programme

Of course, this variability in learning raises interesting questions pertaining to what is involved in developing understanding in a particular subject area, or indeed a particular academic programme. It is important to remember that students' understandings are not always limited just to one or

two subject areas. Many students studying at university follow an academic programme involving (sometimes parallel) study of many different courses on different subject areas, and so these students have to organise their efforts to meet with a variety of disciplinary demands, while keeping track of the over-arching, often professional, purposes of the academic programme. For instance, students following a conventional engineering programme often have to traverse subject areas such as mathematics, physics and mechanics on their way to becoming professional engineers. A recent interview study on Swedish engineering students' experiences of studying and learning (Scheja, 2002, 2006) also found that studying within such a multifaceted disciplinary structure frequently produced particular experiences of understanding characterised by a delay in achieving understanding of topics brought to the fore in the teaching. Such experiences were typically reported by students who constantly felt themselves falling behind and who had a hard time catching up with coursework. The experience of "delayed understanding" has also been noted in recent British research on students' learning of electronic engineering (Entwistle et al., 2005), with students testifying to a substantial deferment of understanding learning material influencing the development of a more general understanding of the subject area.

> "In second year I got a better understanding of what I learnt in first year. Now in third year I've kind of learnt what I was supposed to know in second year. It's a shame that I've never felt that I've learned it in the actual year [it was taught]... When you're being taught something, you're just desperately trying to learn it, and there's not necessarily a whole lot of interest. You're scrambling back to notes [in preparing for the exams], trying to understand the course. [But] at some point during the learning process, you do get interested and [then] things start to fall into place." (Entwistle et al., 2005, 15).

Similar to engineering students, medical students move in and out of several different subject areas – such as anatomy, pathology, biochemistry, physiology, neurology, surgery, and so forth – in the course of studying to become professional physicians. Although few studies have explicitly investigated students' experiences of understanding as they move in and out of these different disciplinary settings, early work on students' conceptions of knowledge (Perry, 1970) suggested that the process of studying in higher education involves a gradual change in the students' perspective on knowledge.

In particular, these studies showed that students are influenced, not only by teaching, but also by their epistemological beliefs about what it means to study and learn. In his seminal work on students' intellectual and ethical development during their college years, Perry (1970) described a progression in students' ways of thinking about knowledge in higher education. Perry identified a developmental pattern in which students traversed different "positions" allowing for varying degrees of intellectual awareness. These positions ranged from a dualistic way of reasoning characterised by a firm belief that there is an absolute truth handed down by "Authority" which should be correctly reproduced in assessments, to more relativistic ways of reasoning characterised by a recognition that all conclusions are based on evidence which must be thoroughly examined to appreciate the soundness – or, indeed, the fallibility – of these conclusions. Perry (1970) also noted that this gradual development – from an absolute conception of knowledge towards an increased awareness of the discipline specific and academic conditions influencing the creation and evaluation of different forms of knowledge – would sometimes take students over a particularly crucial threshold, or "pivotal position". In the course of such a transition students would markedly change their outlook on knowledge and begin to recognise the functions of the various types of evidence collected and used within their discipline; they would also grasp the way that data is analysed, the reasoning processes used to interpret those analyses, and the academic discourse through which the conclusions are reported. However, this transition would not come without effort and students would frequently find themselves wavering between certainty and disbelief in their own knowledge of the world (Perry, 1970, 1988).

Perry's (1970) work was based on annual interviews with longitudinal samples of students at Harvard and Ratcliffe colleges, and subsequent research has largely confirmed the developmental trend identified by Perry (Hofer & Pintrich, 2002), with important qualifications being made with regards to gender differences (Belenky et al., 1986; Clinchy, 2002). In another qualitative study, Säljö (1979) suggested a similar developmental pattern in individuals' common *conceptions of learning*. In interviewing 90 adults from a range of educational backgrounds about their views of learning, he found indications that there existed a hierarchy of conceptions; at the one end of this hierarchy there were individuals describing learning as a question of memorising and reproducing the information being presented and at the other end individuals who saw learning as a process of transforming the information into personal understanding. Later research, building on Säljö's work, suggested yet another distinct conception of learning – learning as "changing as a person" (Marton, Beaty, & Dall'Alba, 1993). The central distinction brought to the fore in this research is between conceptions of learning as an intake and reproduction of content, and conceptions of learning as an active process of transforming content to form new understandings. Similar to Perry's (1970) thinking, these findings suggest a sequential ordering of conceptions of learning implying a movement from reproduction oriented conceptions towards more academically sophisticated conceptions where learning is seen to have transformative and identity-building properties.

Understanding and threshold concepts

In respect of both development schemes described above, students may be seen as moving gradually through different conceptions of knowledge and learning, reaching a pivotal juncture at which the conceptions take on transformative properties which, in turn, may open up a realisation of the relativistic nature of knowledge and understanding. But, how students are able to cross over such thresholds and develop a solid understanding of the subject area in hand is still a largely unresolved question. As learning varies in different disciplinary settings what counts as understanding is also likely to vary across subjects, and so, in order to understand the conditions for teaching and learning in higher education, the research is increasingly focusing on intra-disciplinary aspects of teaching and learning in particular subject areas. The burgeoning research into *threshold concepts* (Meyer & Land, 2003, 2005, 2006; Land, Meyer, & Smith, 2008) can perhaps be seen as an expression of this increasing interest in the conditions for learning in different disciplines. This research suggests that learning to master a subject area involves acquiring certain concepts or conceptual structures that have a defining and nurturing quality to them in relation to the particular discipline concerned. In particular, threshold concepts (such as "opportunity cost" in economics, and "limit" in mathematics) seem to have the potential to open up understanding of various subject-matter topics in important ways. Threshold concepts are commonly mistaken for core concepts which delineate fundamental topics in a given curriculum. Threshold concepts, however, are distinct in sharing the following salient characteristics. They are...

- *Transformative* in the sense that understanding a threshold concept involves a change in the individual's conception of the subject area in hand,
- *Integrative* insofar that the process or achieving an understanding of them involves collating bits and pieces of conceptual material and integrating them into a conceptual whole,
- Potentially *troublesome* for students to grasp, as they often involve thinking beyond familiar ways of conceptualising the topics studied
- *Bounded* by the disciplinary setting to the extent that threshold concepts involve conceptual constraints that are defined by this disciplinary setting with its epistemological and ontological assumptions.

  Irreversible (or, rather, the understanding of threshold concept is irreversible, as is a thorough understanding in general) in the sense that, once understanding has been achieved, this understanding is impossible to counteract or eradicate.

Of these defining characteristics of threshold concepts, the transformative and integrative aspects stand out as perhaps the most important because they imply changes in students' conceptions and cognitive processes that are of crucial importance for the development of understanding within a particular subject area (Davies & Mangan, 2007; Entwistle, 2008; Meyer & Land, 2006). By foregrounding such cognitive and conceptual processes in considering students' understanding of threshold concepts in different subject areas, the research on student learning in higher education is revealing an emergent interest in the process of conceptual change.

Conceptual change and understanding through contextualisation of learning material

The nature and process of conceptual change has, of course, been extensively researched within educational psychology (Vosniadou, 2007, 2008). Early work on conceptual change (Driver & Easley, 1978; Posner et al., 1982) drew primarily on constructivist theories of learning and instruction to investigate students' misconceptions of science concepts and how to bring about desired changes in these conceptions (for an extensive bibliography see Duit, 2006). Later research, however (Caravita & Halldén, 1994; Halldén, 1999; Halldén, Scheja, & Haglund, 2008), has been more concerned with the process of concept formation and the development of conceptual understanding, revealing a more fundamental interest in the nature of conceptual change and in the cognitive and sociocultural dimensions involved in this process.

This recent research stance involves viewing learning as a complex interplay of beliefs at different levels of interpretation. At one level, students may hold beliefs about specific concepts, while at a more general level – a meta-level of interpretation – there appear to exist an equivalent set of beliefs about the very nature of the academic discipline which tend to influence students' ways of understanding and dealing with specific concepts brought to the fore in the teaching (Caravita & Halldén 1994). From this theoretical perspective, learning can be seen as involving a process of approximation and feedback through which students try out interpretations of learning material and, in continuous interaction with peers, teachers, and other significant aspects of the learning environment, develop conceptions of what it means to study and learn a particular subject. Research has explored this concept formation process in terms of a process of *contextualisation* through which students develop personal understandings of learning tasks and concepts by putting them in a particular context or framework where they make sense for the learners in the perceived circumstances (Halldén, 1999; Ryve, 2006; Scheja, 2002). The main hypothesis of this learning theory is that it is through such contextualisation processes, involving the formation of conceptions of both specific concepts and learning tasks and of the nature of the discipline under study, that students may gradually learn to see how understanding is constructed and used within a particular subject area (Halldén, Scheja & Haglund, 2008). Interestingly, this constructivist research shows considerable overlap with the research described earlier on students' experiences of understanding and with the research on knowledge objects, suggesting that learning processes of this kind can lead to highly personalised and contextualised understandings of topics brought to the fore in the teaching (Entwistle & Entwistle, 2005; Entwistle & Marton, 1994; Lundholm, 2005; Wistedt, 1998).

To conclude this section, the notion of students' holding conceptions at different levels simultaneously invites reflection on learning as a powerfully context-dependent process involving a dynamic interplay between learners' personal experiences and capabilities, and their conceptions of the learning environment (Entwistle 2007; Halldén, Scheja & Haglund, 2008). This appeal for context sensitive approaches in the research on higher education makes the research on conceptual change a theoretically attractive platform for thinking about processes involved in developing subject-matter understanding at the university level.

The picture emerging from this overview emphasizes the importance of looking at variations

in students' experiences of understanding in relation to the specific setting in which this understanding is achieved. But to what extent is this concern for understanding and its "situatedness" reflected in more specific research directed towards learning in the disciplines? To answer this question the paper now moves from this general overview of research to consider research into medical education.

3. Research on understanding in medical education

Even a quick look across the body of medical education research makes it quite clear that while the past three decades have seen a remarkable growth of studies within the field, relatively little effort has been put into investigating medical students' experiences of understanding. Reflecting on the past thirty years of medical education research, Norman (2002) stressed that this research has contributed substantially to the understanding of the processes and outcomes of medical training. In particular, basic research on reasoning in medicine has made it clear that generic reasoning or problem solving skills cannot account for medical expertise; such expertise lies primarily in the formal and experiential knowledge that an expert brings to the problem (Elstein, Shulman, & Sprafka, 1978; Barrows et al., 1982). This research pointed to the importance of taking into account the content-specificity of learning, with subsequent research efforts being made to develop reliable methods for performance assessment of clinical reasoning in medical practice (Harden & Gleeson, 1979). Research on medical education has also to some extent focused on comparisons between problem-based learning and more traditional approaches to teaching medicine, with findings suggesting a rejection of the contention that self-directed learning is an inferior form of knowledge acquisition (Albanese & Mitchell, 1993; Vernon & Blake, 1993).

Other research has drawn heavily on cognitive science and mainstream psychology to investigate the ways in which medical experts cognitively organise medical knowledge (Evans & Patel, 1989; Schmidt, Norman, & Boshuizen, 1990; Schmidt & Boshuizen, 1993). In particular, this research has argued that what distinguishes expert physicians from novices is the ability to make use of contextual information effectively in solving clinical cases. Novices tend to draw on disparate pieces of biomedical knowledge in working their way towards a solution of a clinical problem. Experts' ways of reasoning, however, appear to rely on knowledge structures facilitating groupings, or "encapsulation", of relevant information into clinical conceptions that can be brought to bear on the case in hand. Specifically the research suggests that experts, through daily exposure to clinical problems, develop their ability to piece together "illness scripts" in the form of patient narratives matching specific diseases. So, whenever experts are confronted with a new clinical case, they use these illness scripts as a basis for structuring and interpreting the information provided by the patient and the circumstances surrounding the clinical case (Schmidt & Boshuizen, 1993). This research on the development of expertise in medicine also suggests that turning from novice to expert involves going through different phases in which qualitatively different knowledge structures, at different conceptual levels, are used for interpreting medical information and bringing knowledge to bear on a clinical case. Although this research often does not explicitly address students' experiences of understanding, its strong focus on the knowledge structures underlying clinical reasoning shows considerable overlap with research on conceptual change (in particular see Kaufman, Keselman, & Patel, 2008) and so may be of particular relevance to any research concerned with students' experiences of understanding in medicine.

While most medical education research has been linked to mainstream psychology and cognitive science, more recent work within this field has made contributions to the research on student learning in higher education. Fyrenius, Wirélll and Silén (2007), for instance, conducted semi-structured interviews with a sample of undergraduate students to investigate students'

understandings of complex physiological phenomena. Phenomenographic analyses of the interview transcripts revealed two main categories and two subcategories describing qualitatively different approaches to achieving understanding of topics in medical physiology: *sifting*, involving an intention to "take in" and condense information to make this information manageable, and *building* involving an intention to relate learning material to previous knowledge to make personal sense of this learning material. The building category in turn involved two subcategories: "holding" and "moving" describing variations in students' willingness either to hold on to, and strategically make use of understandings achieved, or to flexibly adapt and revise their understandings in light of others' viewpoints. Apart from describing students' approaches to achieving understanding the study went on to explore students' conceptions of how understanding of details is related to the understanding of wholes. Three categories describing different conceptions of this relationship were brought to the fore: (1) a linear category including conceptions in which knowledge of more facts and details was seen as entailing a more complete understanding of studied phenomena, (2) a "competing" category including conceptions in which the understanding of details was seen as interfering with the understanding of wholes, and finally (3) a "collaborative" category involving conceptions implying a simultaneous and mutually supportive development of understanding of details and wholes (Fyrenius, Wirell, & Silén, 2007). In contrast to most other research on medical education, this research on students' approaches to achieving understanding makes an explicit contribution to the research on students' approaches to learning and studying in higher education (Marton, Hounsell, & Entwistle, 2005) in the specific context of medical education, by offering a finer grained analysis of students' approaches to studying than is typically presented in this research area.

To summarise, looking across the research on students' experiences of understanding, knowledge objects, conceptions of knowledge and learning, threshold concepts and conceptual change, there is a clear emphasis in the research that stresses the importance of investigating learning and understanding in the setting in which it takes place. In considering more closely the research on medical education, with its concern for problem based learning, novice-expert differences in clinical reasoning and approaches to achieving understanding in medicine, there is some recognition of the context-specificity of learning, although this contextual awareness does not seem as explicit as it does is in the research on student learning and conceptual change. However, this brief overview of the rapidly expanding research on medical education also makes it clear that, apart from more recent efforts to explore students' approaches to achieving understanding in medicine, the question of how medical students develop and experience understanding in relation to medical studies is less well explored.

4. Students' experiences of understanding in medicine

In a recently launched research project we have taken this concern for understanding in its context as a point of departure in exploring students' experiences and processes of understanding within two distinctly different academic disciplines-engineering and medicine. For the purposes of the present paper, we will restrict the discussion to findings emerging from the medical education part of the project. With the data collection being in its initial stages we do not have substantial amount of empirical data to draw on, but preliminary analyses of ongoing interviews with students in medicine nevertheless provide some useful insights into students' personal experiences of developing understanding in an academic programme involving everything from intensive academic study of basic science subjects to collaborative work in a clinical ward at a university hospital. So, moving swiftly on to the final section of this paper, we start off with a description of the learning environment in which the students pursued their studies.

Brief overview of the medical programme

As already mentioned, this paper draws on interview data being collected in an ongoing study aiming to explore students' development of understanding in medicine. In this study, interviews are being carried out with students on the medical programme in a large Swedish medical school. This programme encompasses eleven semesters. The first four semesters typically involve students taking courses in the wide range of basic medical subjects mentioned earlier. This preclinical phase ends in a preclinical exam covering topics taught in the first two years. The programme then enters a more clinically oriented phase, providing students with frequent opportunities to work with clinical problems in a clinical environment, and to take, in parallel, clinical courses in subjects such as medical diagnostics, medical surgery and clinical medicine. Towards the end of the programme students are also expected to undertake an independent but supervised exam project requiring of them to specialise in a chosen topic of relevance to their medical studies. Teaching at the programme is organised mainly around lectures, seminars and practical training sessions. During the preclinical phase of the programme a typical day often involves students attending lectures from around 8.30am till at least 3.30pm, or sometimes even 6.00pm, with short breaks for coffee and a longer break for lunch. Apart from taking clinically oriented courses, the clinical phase of the programme involves students participating in supervised short term internships at various clinical wards in different university hospitals where they practise the ways of working as a physician, performing basic examinations and assisting in the care taking of patients.

Methodology

Semi-structured individual interviews are currently being carried out with some 20 students in their fifth term at the medical programme. These interviews are exploring the students' overall experiences of understanding in relation to studying on the programme by using a fairly open communicative framework that allows students to talk freely about their experiences of studying, learning and understanding. But the interviews also involve a structuring component in that they frequently prompt students to illustrate and give examples of their understandings and how they think about what it means to understand in relation to pursuing medical studies. The data thus generated form the basis of a conceptualisation of the students' experiences of understanding in this particular academic setting. As hinted at in the research overview presented above, this conceptualisation finds its roots, not only in research on students' conceptual change and learning through contextualisation of learning material (Halldén, Scheja, & Haglund, 2008), but also in research on the forms of personal understanding developed through such contextualisation processes (Entwistle & Entwistle, 1992). Such a combined conceptualisation, linking research on conceptual change with research on student learning, allows reflection both on students' personal experiences of the understanding achieved in relation to studies, and on the cognitive processes through which these experiences develop. In the following, extracts from the interviews will be presented to illustrate students' experiences of understanding. The reflections following these quotes are based on analysis of data currently being collected, so what is presented here represents a first attempt to conceptualise students' experiences.

Students' overall experiences of understanding in relation to studying at the programme

Looking at the interview data collected so far it is clear that, for students, the preclinical part of the programme comes across as very demanding in terms of students having to cope with a multitude of facts and details – a laborious process leaving little room for understanding.

> "When I first came here I read the book and thought I got a good grip on what, for instance, biochemistry was all about. But then it dawned on me that it's not enough

> to know roughly what the molecule looks like. I'm expected to know where each and every carbon atom is located! That's my view of this programme; it's all about knowing the details, and it's very little about intelligence and thinking and reflecting. So far it's more or less been a question of building up a database in your head, and shove knowledge into it. Later, hopefully, you're meant to use that knowledge more analytically in your profession, but at the moment there is no room for analysis, just facts, facts, facts." (M).

This perceived focus on knowing details also led students to reflect on the relation between acquiring knowledge of details and grasping the big picture respectively.

> "I've really missed getting the whole picture. A lot of the time the focus is on details and small areas of factual knowledge and the big [picture] tend to disappear. I'm not sure how this [picture] could be communicated, I mean what comes first?" (H).

But the students, now in their third year of medical studies, also talked about a gradual change in their understanding of the topics studied indicating that, as the programme entered its more clinically oriented phase, the initial – and almost exclusive – focus on details began to make sense in view of an emerging understanding of how different topics are related to one another and how understanding of these relationships can contribute to a more general understanding of medicine.

> "Do I have to have to know the details to understand the whole and is that why I'm beginning to see the big picture now? Or, if they had tried to give me the big picture from the start, perhaps I wouldn't have understood it, because I didn't know the details?" (H).
>
> "It's a bit like doing a jigsaw puzzle. You have that image on the lid of the box and then you start to place a few pieces and you really can't see what it's supposed to be, but as you piece together more and more pieces it dawns on you. I think that description comes pretty close to [what it's like to understand]." (A).

This experience of an understanding that gradually falls into place seemed to be strongly linked to a feeling of topics reappearing in the teaching and an ensuing sense of grasping these topics post-hoc.

> "The structure of the programme is that it continually adds on. First term it's the structure and function of the cell... that course is pretty difficult and boring. You have to get through it. Then you realise, as the terms pass, that it was probably quite a good idea to take that course, because everything keeps coming back and you tend to grasp things afterwards." (A).

Another student went on to take an example of how the topic of respiratory functions, brought to the fore in the preclinical part of the programme, reappeared in one of the first clinical courses and how the repetition of the substance of that topic facilitated the understanding of details in relation to a more general understanding of respiratory functions in relation to the human body as a system.

> "At the moment there is less talk about details, but we've already got those [from previous preclinical courses]. Now it's more like they raise a topic and then do a quick review. I've had several aha-experiences when they've said: 'We'll just quickly repeat this, you already know this but we'll do a quick review of this organ'. Then they say something very quickly about the respiration and how oxygen can be moved around [in the body]. Then you get that simple explanation and you already have the details somewhere in the back of your head, but you get that 'aha'-feeling that that's the essence of it, that's the important stuff; oxygen is actually left in the muscle and then the blood cell must return and get refilled. That was the

> essence of what we learned, but we didn't 'get it' then, because we were staring ourselves blind at figures showing how much carbon dioxide there was in the air, what the pressure differences were between the pulmonary artery and the capillaries, and so on. You never grasped that the real point was to leave the oxygen and remove the debris. In that case you understood it because that's something you've brought with you; that's something we, as a culture, have a general understanding of. I think the repetition we get now is often very useful and ties together what you already know." (H).

Interestingly, the experience of beginning to understand how topics and themes relate and of "seeing the big picture" seemed to be particularly pronounced in relation to students moving from the preclinical to the more clinically oriented phase of the programme. As the students were confronted with clinical cases in a clinical environment, what had initially appeared as disparate pieces of a jigsaw puzzle suddenly started to come together to form a coherent image.

> "You somehow manage to bring the picture together [---] as you put the courses behind you, everything gradually falls into place and you're able to connect the molecules with diseases and medicines, yeah, everything is being linked together" (A).

Reflecting on both the structure and the content of this image, students also stressed the importance of establishing a birds-eye view of topics taught, enabling an understanding at the micro level.

> "There's like a lot of systems that merge, but they merge into a larger system which is a human being. I think that's good, it works for me to look at it as a system. Obviously, you can narrow things down and get even smaller systems; the cell is also a system but if you have complete control of slightly larger systems of the human body, for instance heat regulation or the regulation of fluids, it's much easier to concentrate on the details. If you don't know anything about [the larger systems] you won't be able to remember the details. There's a lot of stuff from the first semesters, a lot of information that goes out the window because you cram it in, but you don't know where to put it because you don't know in which 'folder' it belongs. The things that you have a general understanding of remain much longer in memory" (H).

5. Conceptualising students' experiences of understanding in medicine

The extracts presented above indicate that students' experiences of understanding undergo an important transformation as they move from preclinical studies to the more clinically oriented courses. While the focus on facts and details, prevalent in the students' descriptions of their preclinical training, offered experiences of understanding built mainly on memorisation and acquisition of facts at the micro level (*"I'm expected to know where each and every carbon atom is located!"*), the shift to clinical training apparently brings with it a change in the understanding achieved enabling connections between topics previously brought to the fore in the teaching and integration of disparate pieces of information into a larger whole (*"There's like a lot of systems that merge, but they merge into a larger system which is a human being"*).

An important observation to be made in relation to this is the apparent delay in understanding described by students through statements like: "*everything keeps coming back and you tend to grasp things afterwards*". However, unlike engineering students who often tend to experience delayed understanding as an obstacle for learning (Entwistle et al., 2005; Scheja, 2002, 2006), the medical students seemed to be rather comfortable with the notion of understanding coming little by little. In fact, it would almost seem as if the experience of grasping topics post-hoc is expected in view of

the repetition provided by teachers in later courses and particularly so in the clinical phase of the programme where students are prompted to actively bring their previous understanding to bear on clinical problems. Drawing on the notion of threshold concepts (Land, Meyer, & Smith, 2008), it might perhaps even be suggested that the move itself from preclinical to clinical studies in medicine requires a critical transformation in the students' thinking involving bits and pieces of information being integrated into a more general understanding of the practice of medicine.

This last comment touches on not only the question of how these medical students' experience understanding, but also the question of how such experiences are produced. Being in its early stages, the research presented here cannot, of course, hope to produce a complete conceptualisation of this process. However, studying the way in which students reflect on their own experiences of understanding in relation to medicine, it is interesting to consider the image of understanding communicated above by students in terms of a process in which systems merge into a "larger system which is a human being". The emphasis put on understanding as a question of grasping the form and function of larger and smaller systems certainly invites reflection on the interrelationship between these systems in terms of students' conceptions, on the one hand of the nature of medicine and the other of the facts, the concepts, techniques and procedures forming part of medicine as a disciplinary area.

As mentioned earlier, research on student learning and conceptual change (Halldén, 1999; Scheja, 2002; Ryve, 2006) has introduced the notion of contextualisation to describe how students develop personal understandings of learning tasks and concepts by putting them in a particular interpretive context or framework where they make sense for the learners in the perceived circumstances. The research flowing from this conceptual framework suggests that learning involves the formation of conceptions of both specific learning material and of the nature of the discipline as a whole, and that it is through attempts to relate these interpretive levels that students may gradually learn to see how understanding is constructed and used within a particular subject area (Halldén, Scheja, & Haglund, 2008). Reflecting on the apparent transformation of the experiences of understanding reported by medical students in this paper, and using the notion of contextualisation, the shift observed in students' experiences may perhaps be conceptualised in terms of a *contextual mapping* process. By gradually beginning to see the contours of the interpretive contexts within which various topics presented in the teaching are bestowed, their medical significance and how different contexts may be differentiated and related to one another to form a larger whole, the integration of previously scattered bits and pieces of information with entire medical contexts may be made possible (cf. Halldén, Scheja, & Haglund, 2008).

As research on conceptual change has shown, the development of conceptions may take place at different levels of abstraction, allowing a range of transformations of students' experiences of understanding to occur (Caravita & Halldén, 1994). Recent research on student learning has argued that true understanding of a particular subject area mainly comes from developing an understanding of threshold concepts (Meyer & Land 2006). However, looking at the students' personal reflections on their own experiences of understanding, and drawing on the notion of conceptions existing at different levels, developing an understanding of medicine seems to involve, not just the conceptualisation of single concepts, facts and techniques that can be applied to solve clinical problems, but also the development of more fundamental epistemological conceptions of the nature of the discipline of medicine as systemically organised into systems at the micro, meso and macro levels. If such conceptions are seen as interacting in shaping students' conceptions of medical topics in relation to everyday studying, developing an understanding of medicine would necessarily involve contextualising those topics in relation to overarching conceptions of what the discipline is all about, which in turn would influence the understanding of specific concepts and ways of dealing with available clinical procedures and

techniques. For students, coming to an understanding of medicine would thus involve a complex, multilayered process of building discipline-like contexts for understanding by mapping personal contextualisations of learning material onto the disciplinary cue-structure provided in the teaching, the literature and the continuous interaction with teachers and fellow students in the learning environment. Of course, a great deal of research is needed before the empirical value of such a conceptualisation of students' experiences of understanding can be assessed. In the meantime, this way of thinking around students' understandings may serve to open up an analytic pathway to studying crucial variations in the process through which students' subject-matter understandings emerge in interaction with their learning environment.

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Εννοιολογώντας τις εμπειρίες κατανόησης φοιτητών Ιατρικής

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Περίληψη

Η εργασία έχει ως αφετηρία την τρέχουσα ερευνητική δουλειά που εστιάζει στη μάθηση των φοιτητών στην ανώτατη εκπαίδευση, προκειμένου να αποτελέσει τη βάση για την εννοιολόγηση των εμπειριών κατανόησης φοιτητών Ιατρικής. Ξεκινώντας με μια περιορισμένη επισκόπηση της έρευνας σχετικά με τη φύση των εμπειριών κατανόησης των φοιτητών, η εργασία στη συνέχεια εξετάζει τις έρευνες σχετικά με προσωπικές κατανοήσεις που αναπτύσσουν οι φοιτητές στο πλαίσιο των αντικειμένων γνώσης. Δημιουργώντας στη συνέχεια συνδέσεις με τις επιστημολογικές πεποιθήσεις των φοιτητών, παρουσιάζονται περαιτέρω συσχετίσεις με πρόσφατες έρευνες σχετικά με έννοιες «ουδούς» και τη σχετική έρευνα για την εννοιολογική αλλαγή. Έναντι στο θεωρητικό υπόβαθρο που προσφέρει αυτή η σύντομη επισκόπηση, στην παρούσα εργασία εξετάζονται έρευνες που έχουν διεξαχθεί στο χώρο των ιατρικών σπουδών και στη συνέχεια χρησιμοποιούνται δεδομένα συνεντεύξεων που έχουν πρόσφατα συλλεγεί στο πλαίσιο ενός Σουηδικού ερευνητικού προγράμματος, προκειμένου να παρουσιαστεί μια πρώτη εννοιολόγηση των εμπειριών κατανόησης φοιτητών Ιατρικής.

Λέξεις-κλειδιά: Συνεντεύξεις, εμπειρίες κατανόησης των φοιτητών, ανώτατη εκπαίδευση, σπουδές στην Ιατρική.

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