Abstract

The past decade has seen a sharp increase in concern for developing teaching and learning in higher education. Recently, the idea of the Scholarship of Teaching and Learning - making transparent how learning has been made possible - has begun to take on increasing significance in the student learning literature dealing with higher education.

Against this background this thesis reports on a phenomenographic study of the variation in how physics lecturers craft their teaching practice in relation to how they know their students as learners.

13 semi-structured interviews with physics lecturers drawn from two Swedish universities were conducted. The interviews were transcribed verbatim. From the transcripts five phenomenographic categories of description are described and illustrated, and suggest a contribution to the notion of disciplinary style in university physics teaching.

Prologue

Welcome. I would like to introduce you to my personal thoughts of the work as a teacher within natural science and technology and link that with the licentiate thesis I hope you are about to read.

I started my career at the university as a lecturer in computer science after I got my master exam in Physics. My special interest was computing meteorology which led me to work as a lecturer in computer sciences. When I started lecturing I had no pre-knowledge of teaching. The only experience I had of education was being a student myself. The tools I had were to trust my instincts, the culture code of the subject, suggestions made by my colleagues, and my knowledge of the subject. This meant that my way of looking at my students' learning was strongly colored by the natural sciences' way of viewing the world because I was fostered in that way of observing and understanding the surrounding world. During my first year as a lecturer I learned that my way of categorizing the world was not very useful if I wanted to understand my students' way of learning, which was necessary to become a better teacher. It is very easy to categorize people into groups and stick to that idea, but I have been proven wrong so many times by now that I don't dare to do that any more. Still, it is useful to listen to other people and understand their ways of grouping behavior as this will broaden your own spectrum of perceiving people's ways of learning. When I understood that my way of approaching my students needed improvement I attended a pedagogic course for lecturers at Uppsala University. There I learned the basics in pedagogy and met people from various subject fields to discuss with. This experience made me reconsider my own time as a student and understand that things were not as 'obvious' and 'absolute' as I had thought. This in turn helped me to view my students differently.

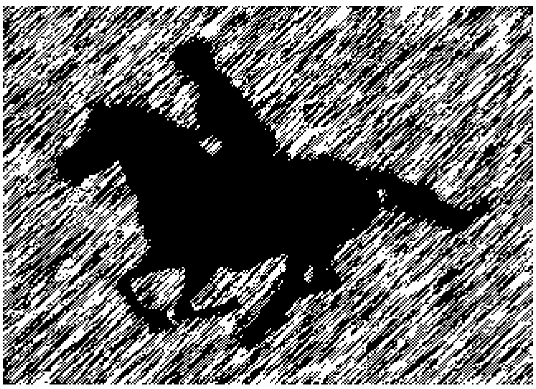
I also had (and still have) dynamic discussions with my colleagues. This was very stimulating and important for the progression of me as a lecturer but also for developing the courses we were offering. As a conclusion I would say that qualitative conversations with colleagues and students together with trying to implement ideas in the teaching have been by far the most productive way of improving as a lecturer. Of course knowledge development within the subject is important too, but to become a good lecturer one has to be aware of the different ways the subject can be learnt. This is what scholarship of teaching and learning is about, to have an ongoing discussion and development of educational matters within one's own subject. To give you an appreciation of a lecturer's way of experiencing his practice I would like to urge you to read appendix B, where I have given a full interview example of one of the interviews I performed for this study. Personally I adore this particular interview because it expresses such strong feelings and it feels very genuine to me. It also pictures the difficulty of grasping terms that we as natural scientists are not used to and how we adjust to that natural scientists way of discussing . As a tip, look at the last part of the interview. I have only one thing to say, I hope I have a better grasp of the term scholarship today!

I hope this licentiate thesis will contribute to discussions among science educators as well as science lecturers. To me, very useful way of viewing scholarship of teaching is what Mary Taylor Huber and Pat Hutchings said:

> The scholarship of teaching and learning invites faculty from all disciplines and fields to identify and explore those questions in their own teaching - and, especially, in their students' learning - and to do so in ways that are shared with colleagues who can build on new insights. In this way. such work has the potential to transform higher education by making the private work of the classroom visible, talked about, studied, built upon, and valued - conditions for ongoing improvement in any enterprise (Huber and Hutchings, 2005, p. ix).

I am ending this prologue with a couple of questions for you that you can bear in mind when reading parts of or the whole thesis:

- How would you have answered the interview questions?
- If you compare your answers to the interview questions and my results, will that inform you of your way of practicing teaching?



Acknowledgments

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But, there are a lot of other people who have supported me enormously during the work and foremost I would like to show my gratefulness to my husband Gustav, my mother Pia, and my father in heaven. My colleagues both in the physics education group and at the division of scientific computing (TDB) are very important and supportive to me, thank you.

I hope we all are going to enjoy the rest of the journey to a Phd-thesis!

Contents

1 Introduction to the study

1.1 The problem and the purpose of the thesis

One could say that the aim of university teaching is to make learning possible (for example, see Ramsden, 2003) within the taught area. The aim of the scholarship of teaching and learning (SoTL) is about making transparent how learning is made possible (Trigwell et al., 2000) through the crafting of teaching practice. Thus, lecturers' practice should be made available for public critique so the whole community can acquaint itself with the teachers' craftsmanship and develop the teaching and learning practice.

My experience as a teacher tells me that the cooperation with colleagues is very important. Equally important is knowledge about the subject, pedagogical techniques, student learning, social structures, etcetera. SoTL is a concept used to grasp this. Being scholarly is often thought of as having academic rank at a university and being engaged in research and publication. This, however, overlooks another of the main purposes of our universities, to educate people. This became an issue at the beginning of the 1990s. The SoTL has become increasingly important. Two of the most influential researchers in the area argue that SoTL is "a set of habits and dispositions for meeting the challenges that we all face as learners and citizens in the twenty-first century" (Huber and Hutchings, 2005, p. 2). The key features of SoTL are under much debate. Another leading researcher in this area characterizes SoTL as "exploring relationships between teaching and learning, research, and integrating and applying knowledge", "effective teaching through the wisdom of practice and standards of disciplinary scholarship", "knowledge about teaching and learning through reflection on practice", "specific research skills, attitudes, and products", "development of pedagogical content knowledge through reflection", and "sharing and peer review of information and insight" (Kreber, 2002a, p. 157–159). Thus, SoTL is meant to be inspiring for and continously developed by lecturers at our universities.

This thesis contributes to SoTL with a comprehensive description of qualitatively different ways that physics lecturers craft their practice in a physics teaching context. The categories formed out of the data describe distinct attributes that can broaden the understanding of the notion of SoTL in the discipline of physics. This will contribute to showing us, as researchers in SoTL and practitioners of teaching and learning, what is the common ground to start a reflective change in the practice of SoTL.

1.2 The research question

The work presented in this thesis stemmed from an interest in broadening the SoTL from physics lecturers' perspective. The question I wanted to elaborate on is:
how physics lecturers perceive that they have made learning possible in terms of how they craft their teaching practice in relation to how they come to know their students as learners.

The aim is to increase the understanding of how physics lecturers formulate, reflect and put into practice the conditions they feel make learning possible in the physics discipline. I want to better understand the way they present physics phenomena to students, how they value students' and colleagues' knowledge and learning, choice of pedagogy, and so on. Physics is an old subject and the paths of knowledge-making are well worn. This implies, as for many other subjects, that ideas around issues such as ontology and epistemology are well established and color people's reflecting thoughts. One could say that every subject discipline has its own culture within which everyone practices. My aim was to capture insights into the ways in which the disciplinary style of university physics shapes the SoTL.

The final outcome was the formulation of five qualitatively different categories of ways of crafting university-physics teaching practice. The categories gave a notion of crafting-of-practice situated in how university physics learning is considered to be best made possible. From my data analysis the following categories emerged: practice founded on techniques for presenting, practice founded on presentation of content, practice founded on intrinsic gratification, practice founded on shaping of environment, and practice founded on students engagement. These categories will be fully discussed in the chapters Results and Discussion.

1.3 Significance of thesis

The relations: teacher-knowledge, teacher-action and student-learning, that I look into draw on the work of Trigwell and Shale (2004) and Prosser and Trigwell (1999). In particular, these relations draw on Trigwell and Shale's (2004) notion of pedagogic resonance, which represents the part of students' experience in the act of teaching that contributes to their potential to learn. This can be seen as a metaphorical teacher-learner bridge that attempts to capture what takes place within the dynamics of successful interactive teaching. I will argue that this interactive process between lecturers and students will contribute to a broadening of the understanding of the notion of SoTL in university physics.

1.4 Description of terms used in the thesis

The following is a list of terms used in the thesis with descriptions of the way in which they have been used.

Categories of description: "... qualitatively different ways a phenomenon may appear to people of one kind or another. Thus categories of description refer to the collective level" (Marton and Booth, 1997, p. 128).

Conception: "An experience or a conception of a phenomenon - the internal relation between subject and object - is a way of delimiting an object from its context and relating it to the same or other contexts and it is a way of delimiting component parts of the phenomenon and relating them to each other and to the whole" (Marton, 1994).

Crafting-of-practice: The notion of crafting-of-practice is taken to characterize skillful, knowledgeable, reflective and conceptually based activity.

Discipline: "An academic discipline, or field of study, is a branch of knowledge which is taught or researched at the college or university level. Disciplines are defined and recognised by the academic journals in which research is published, and the learned societies and academic departments or faculties to which their practitioners belong" (Wikipedia).

Epistemology: Student or teacher beliefs about the nature and scope of knowledge.

Metacognition: "... the amalgam of student knowledge, awareness and control relevant to their learning" (Gunstone, 1991, p. 135).

Outcome space: "... the outcome space is the complex of categories of description compromising distinct groupings of aspects of the phenomenon and the relationship between them" (Marton and Booth, 1997, p. 125).

Reflective thought: "... active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends" (Dewey, 1933, p. 118).

Ways of experiencing: "The ways of experiencing the world, the phenomena, the situations, are usually taken for granted by the experiencer; they do not see them, they are not aware of them. In phenomenography, where a second-order perspective is taken, it is these underlying ways of experiencing the world, phenomena, and situations that are made the object of the research." (Marton and Booth, 1997, p. 118) "... way of experiencing something is thus twofold: discernment of the whole from the context on the one hand and discernment of the parts and their relationships within the whole on the other hand" (Marton and Booth, 1997, p. 87).

1.5 Survey of parts of the thesis

This chapter has presented the significance of the study, the research questions, and descriptions of the specialist terms used. Chapters 2 and 3 present a literature review grounding the study in its foundational disciplines of physics education research and scholarship of teaching and learning. In Chapter 4 the methodology of the study is presented. Chapter 5 presents the results of the study which are discussed in Chapter 6. Chapter 7 suggests topics for future work. The interview protocol used in the study and a full transcript of an interview can be found in the appendices.

2 Literature review of physics education research

Physics education research (PER) in higher education, which this thesis contributes to, is a goal-oriented field that is typically situated in physics departments. The main general purpose is to " understand how teaching and learning works in order to be able to teach our students more effectively" (Redish, 2004, p. 1). According to a resource letter, one of the major responsible factors for change in the teaching of physics was "results from physics education research" (Thacker, 2003, p. 1834). Various focuses have emerged within PER which contribute to better learning within physics, and the main issues were arguably to understand "attitudes toward physics courses" (Aalst, 2000, p. 57), "studies of student conceptions" (Aalst, 2000, p. 58), and "epistemological beliefs" (Aalst, 2000, p. 61).

PER is a developing subfield in physics and the researchers are likely to use "a scientific approach that combines observation, analysis, and synthesis like the one that has been used so effective in helping us make sense of the physical world" (Redish, 2004, p. 1). But there were

> ... several important differences between physics and PER that need to be underscored. (1) In physics, there is much agreement about the interpretation of concepts. For example, although the concept 'electron' may conjure up varying meanings for physicists working in different sub-disciplines, most physicists would agree that it has mass and charge, and that it is a building block for a number of theories (e.g., of superconductivity and of weak interactions). (2) Theories built from such concepts have a high degree of predictive and explanatory power. (3) Physicists are realists. For example, they believe that the notion 'electron' corresponds to physical particle. By comparison, in physics education - and educational research in general - there is much less agreement about basic ideas such as 'learning', 'concept', and 'mind'; theories have less predictive and explanatory power; and a realist distinction between a theoretical notion and physical reality is more contentions (Aalst, 2000, p. 66).

2.1 Student difficulties

In the early stages of its development, PER focused on students' difficulties in understanding the curriculum mainly in introductory physics courses. In the 1950s and 1960s the curriculum in high school physics was generally considered "a course syllabus, a text, a collection of standard problems, and a set of prescribed laboratory experiments" (McDermott, 1991, p. 302), which McDermott calls "the post-Sputnik era" (McDermott, 1991, p. 304). Later, a growing body of knowledge about student learning in physics was gathered through numerous investigations, and the teaching and learning of physics became a subject of scholarly inquiry. Three different main groups have contributed to our knowledge of student difficulties: physicists, cognitive psychologists, and science educators (McDermott, 1991). The growing interest has been toward the mismatch between ideas students hold when coming to the physics classes and concepts of classical physics. The ideas brought by the students are often given labels such as pre-conceptions, misconceptions, naive theories, and alternate conceptions. McCloskey, for example, completed an investigation into students' misconceptions about motion and compared this to the Aristotelian and medieval impetus theory. He concluded

> ... that the naive impetus theory is very strongly held and is not easily changed by classroom physics instruction. [And therefore it may be useful] for physics instructors to discuss with students their naive beliefs, carefully pointing out what is wrong with these beliefs, and how they differ from the views of classical physics. In this way students may be induced to give up the impetus theory and accept the Newtonian perspective (McCloskey, 1983, p. 319)...

Another example representative of research categorizing students' conceptual understanding of physical phenomena was presented in an article by Finegold and Grosky (1991). They concluded that

> ... many students are being unable to identify the important elements in a system and to reach appropriate conclusions. ... We need conceptual change strategies that focuses not only on eliminating non-scientific beliefs like motion forces, but which extract general rules from particular instances (Finegold and Grosky, 1991, p. 110).

In order to help teachers recognize their students' conceptual difficulties Hake (1998) suggested the use of quantitative pre-/post-test results to create unique interactive-engagement approaches to teaching physics. The most commonly used tests were the Halloun-Hestenes Mechanics Diagnostic test (Halloun and Hestenes, 1985), the Force Concept Inventory test (Hestenes et al., 1992), and the problem-solving Mechanics Baseline test (Hestenes and Wells, 1992). There are also studies made in other physics areas than mechanics, for example in thermodynamics (Yeo and Zadnik, 2001), and electricity and magnetism (Maloney et al., 2001).

2.2 New teaching methods

The inquiry into students' conceptual difficulties has given rise to development of new teaching methods in lecture-halls, classrooms, and at the student laboratory. Meltzer and Manivannan (2002) reported on transforming the lecture-hall environment, based on seven years of development, and testing fully interactive physics lectures. Their goal was to transform "the lecture class, to the furthest extent possible, to the type of instructional environment that exists in an instructor's office" (Meltzer and Manivannan, 2002, p. 641). Crouch (2004) and colleagues have examined the variation of the learning outcome of classroom demonstrations using different demonstration pedagogics: 'observe', 'predict', and 'discuss'. Their results lead to two clear conclusions:

> ... students learn little, if anything, from traditionally presented classroom demonstrations, ... giving students a couple of minutes to predict the outcome and record their predictions cost very little time and yields better understanding (Crouch et al., 2004, p. 837).

There are many investigations reported on the topic of improvement of student learning. To get a good overview of research into new teaching methods, see for example an article by McDermott and Redish (1999). The purpose of this article was "to contribute to an establishment of a research base that can serve as a resource for ongoing improvement and enrichment of student learning in physics" (McDermott and Redish, 1999, p. 755).

2.3 Theory development

A development of theory to underpin the work on student difficulties started at the end of the 1980s. This led to an awareness of a range of other factors influencing learning, such as attitudes towards the subject, beliefs about what knowledge and learning are, and general skills. Smith, diSessa and Roschelle (1993) reconceived the misconception research to a theoretical perspective from a constructivist platform which aimed "to characterize the interrelationships among diverse knowledge elements rather than identify particular flawed conceptions" (Smith et al., 1993, p. 116). The heart of their argument was to avoid the 'expert-novice paradigm' that focused on "apparent differences in form between students' and experts' knowledge" (Smith et al., 1993, p. 127), and instead to take on the idea "that explanation is an everyday activity" (Smith et al., 1993, p. 128). They came up with a set of theoretical principles which went beyond the epistemological premises of constructivism: 'fundamental commitments', 'continuity', 'functionality', and 'a systems perspective'.

In a monograph, 'Toward an Epistemology of Physics', diSessa (1993) presented an approach to study "humans' sense of physical mechanism centers on identifying analyzing specific elements of knowledge" (diSessa, 1993, p. 111), which has become the base for much research since then. He analyzed students' 'preconceptions' in problem solving and he referred to them as 'knowledge in pieces' or phenomenological primitive, p-prim for short. The aim with the monograph was to develop a theoretical framework, but he also presented how one can capture p-prims in empirical studies. diSessa built his argument on fundamental constructivist principles that claimed that new knowledge arises from old knowledge. In addition, he claimed that "Similarly, p-prims evolve from earlier knowledge so that earlier knowledge provides good hints for later" (diSessa, 1993, p. 123).

Another very influential researcher, Redish, recently proposed a theoretical framework built on neuro-science, cognitive science, and phenomenological observational sciences of human behavior. He argued that because he is a physicist he naturally tends to be a reductionist, thus, it was relevant for him to focus the study on the mechanical functioning of the brain, as it is composed of biological components - neurons in particular. His goal was "to develop a sufficient understanding of the cognitive structure of knowledge building to be able to predict what environments are likely to be more effective for more students" (Redish, 2004, p. 7). The focus lay on the individual, "how the individual thinks and how the individual's thinking interacts with her environment" (Redish, 2004, p. 42). The theoretical framework was built on eleven principles: most of them considered cognitive mechanisms - association and control. In order to set up a model to describe students' knowledge you "need to specify the resources that are available for the tasks of interest and how they are associated in the relevant contexts" (Redish, 2004, p. 16). When he developed his model he used the model presented by diSessa (1993) that, in Redish's view, "identifies a particular set of schemas as a set of resources relevant for physics learning: the phenomenological primitives (p-prim for short)" (Redish, 2004, p. 16).

2.4 Other factors influencing learning

The development of theory led to an awareness of other factors influencing learning, such as attitudes towards the subject, beliefs about what knowledge and learning are, and general skills.

2.4.1 Epistemology

Hammer and his collaborators made ground-breaking moves when they took on an epistemological perspective (about the nature and scope of knowledge) in PER. They wanted to frame their questions in terms of when and how students activate their cognitive resources, and they broadened the definition of conception to include students' everyday thinking involving a myriad of cognitive resources. In this way they wanted to "attribute cognitive structures at other levels, as mini-generalizations from experience whose activation depends sensitively on context" (Hammer et al., 2004, p. 6). This was called a resource-based view, which they claimed was better to use to understand students' ways of learning physics. They were escaping the unitary ontology which claimed that "a given concept is a cognitive unit that a student either does or does not possess" (Hammer et al., 2004, p. 22). Instead, with a resource-based ontology, they said that

> Learning a new idea is not an all-or-nothing acquisition but involves an activation of existing resources in new combinations, and this may facilitate subsequent reactivation in one of two ways. In a passive mechanism, reuse raises the probability of the pattern activating again. In a deliberate mechanism, the learner is aware of and choosing to maintain the pattern. (Hammer et al., 2004, p. 22)

As epistemological considerations became a more established perspective within PER, other research methods began to be used. Lising and Elby (2005) performed a case study in order to "look at students' attitudes, expectations, and epistemologies" (Lising and Elby, 2005, p. 372). Their whole study and their hypothesis were based on one person whom they interviewed and videotaped when working in tutorials and in the student-laboratory. The hypothesis they wanted to develop was about the causal relationship between one student's epistemology and that student's learning. From this case study they conclude that

> ... we must learn to identify the epistemological resources that students possess and to understand which resources they are using during the learning process, so that we can help them to choose

> the more productive approaches to learning (Lising and Elby, 2005, p. 381).

A different perspective considering how epistemology influences the learning of physics was used by Linder (1992), who explored how teachers' epistemological beliefs affect students' learning. Linder performed an inquiry into how physics students explain sound and argued that "metaphysical realism overtones in physics teaching not only affects how we teach but also affects how students view the learning and understanding of physics" (Linder, 1992, p. 111).

2.4.2 Metacognition

In the discussion of students' conceptual change one can rather use the term belief instead of conception according to Gunstone (1991), because it is more a belief system than a concept system that has to change. Or, put in another way, "student beliefs about learning/teaching/the nature of physics can be barriers to learning" (Gunstone, 1991, p. 133). In several studies it has been shown that if

> ... learners' ideas and beliefs about learning/teaching etc. are in conflict with the notion that learners must recognize, evaluate and reconstruct their existing physics ideas, then little progress is possible (Gunstone, 1991, p. 135).

In order to accomplish conceptual change in physics we have to improve students' metacognition ("the amalgam of student knowledge, awareness and control relevant to their learning" (Gunstone, 1991, p. 135)). Gunstone concluded that

> Teaching, learning and assessment approaches must both recognize these learners ideas and beliefs, and seek to shift these ideas/beliefs to ones which will allow a recognition of the value to learning of constructivist and metacognitive approaches (Gunstone, 1991, p. 139).

2.4.3 This study

This study can be seen as contributing towards the broad area of epistemological factors influencing teaching and learning. Essentially the study presents possible 'epistemology-in-action', as the categories characterize how teachers may draw on their beliefs about teaching and learning as they formulate their practice. In the next section I will introduce the scholarship of teaching and learning and explain how this thesis is contributing to that area as well.

3 Introduction to teachers' crafting of practice and the scholarship of teaching and learning

> Scholars of teaching and learning understand classroom difficulties as problems and puzzles to be systematically explored and addressed in ways that contribute to a growing teaching commons. (Huber and Hutchings, 2005, p. 14)

The research in this thesis was anchored in the crafting of teaching practice and how this relates to the scholarship of teaching and learning. The aim of this section is to provide a broad insight into these constructs.

3.1 Teachers' crafting of practice

In this thesis the notion of crafting-of-practice was used to capture the variation in the nature of teaching practice as a perceived skillful, knowledgeable, reflective and conceptually based activity. In this model such practice was constituted by general pedagogical knowledge, curriculum content knowledge, knowledge about the educational environment, by what Connelly and Cladinin (1988) have characterized as "personal practical knowledge" and by what Grimmett and MacKinnon (1992) have characterized as "pedagogical learner knowledge". Crafting of practice was an activity outcome that was carefully formulated from a "reflectively considered" (Schön 1983, 1987, 1991) response to lived experience in the practice setting. It was driven by understanding and beliefs about how students best learn. The notion of crafting-of-practice I developed for my thesis work is an extention of what Shulman (1986) has characterized as "wisdom of practice" and "pedagogical content knowledge" to create a conceptually supported "craft conception of teaching" (Grimmett and MacKinnon, 1992). Thus, the notion of crafting-of-practice is here taken to characterize skillful, knowledgeable, reflective and conceptually based activity.

3.2 'The birth' of scholarship of teaching and learning

From the society's point of view, the university lecturer has played many different roles over the years. In the early days of the university the focus was on preparing students for civic and religious leadership so they would be able to serve and reshape the society. The role of the university lecturer was then to teach. Later on, in the late nineteenth centaury, there was a shift in the universities' focus towards research. Society started to take on scientific rationality, which promoted a faster growth of the modern nations. Federal research grants began to support this, and research and graduate education formed the model for the modern university. One direct implication of this shift of focus in the work at the university meant that when hiring a new lecturer the critical selection attribute became centered around scholarship of discovery rather than scholarship of teaching (Boyer, 1990).

In the 1960s pedagogical issues started to be debated and discussed in the higher education community (Huber and Hutchings, 2005). Being a good teacher was not appreciated as much as a good researcher in the academic world. This emphasis was what Ernst Boyer, together with colleagues, found troublesome. In his report (Boyer, 1990) he brought attention to which activities of the university lecturers were the most highly prized. He questioned this valuation and how that affected the education of the students. Both students and lecturers were suffering from the focus being on only research and publication, rather than also on teaching. Research and publication had become the primary means by which most lecturers achieved higher academic positions. He brought credible attention to the extension of the concept of scholarship to include teaching. The report was exceptionally influential, mostly in the USA, where debate around teaching versus research had grown tired and old. Boyer's ideas offered a way of viewing academic value as a set of separate yet overlapping scholarships. These were: discovery, integration, application, and teaching. Separately they can be summarized as follows:

> (a) the scholarship of discovery - close to the old idea of research;
> (b) the scholarship of integration - which involves making connections across the disciplines and placing the specialties in larger context;
> (c) the scholarship of application - which goes beyond the application of research and develops a vital interaction and so informs the other; and
> (d) the scholarship of teaching - which both educates and entices future scholars by communicating the beauty and enlightenment at the heart of significant knowledge.
> (Trigwell et al., 2000, p. 155)

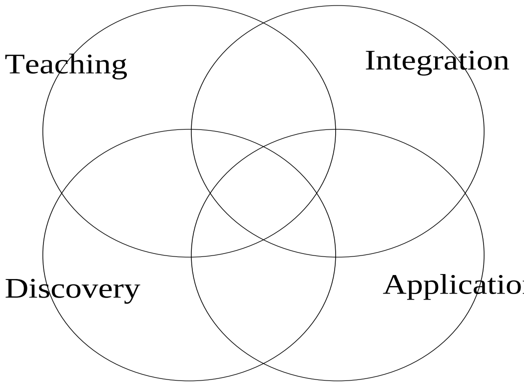

Figure 1: Overlapping scholarships

The four versions of scholarship of teaching and learning (SoTL) have overlapping parts creating a balanced completeness of the profession as a lecturer. Figure 1 shows how this is commonly illustrated. Later, other contributors in the field added 'and learning' to the category of scholarship of teaching. So, taking the aim of university teaching to be about making learning possible (Ramsten, 2003), then the SoTL is about how it is made transparent - shared for critique, adoption and development.

3.3 Clarification and development of Boyer's notion of scholarship of teaching

The characterization of scholarship of teaching by Boyer did not clearly situate 'scholarly teaching' within SoTL. This opened up a diversity of opinions regarding where to situate 'scholarly teaching'. What follows is an overview of some of the most influential contributions to this debate.

Rice (1992) proposed an extension of the idea of SoTL and he used Boyer's four categories in this work. He attempted to make scholarship "more adaptive for both institutions and the day-to-day working lives of faculty" (Rice, 1992, p. 117). With his enlarged view of scholarship the students and their learning were included into the concept which meant that scholarship should "acknowledge and build on the relational nature of knowledge as well as more abstract, objective ways of knowing" (Rice, 1992, p. 128). He saw that scholarship of teaching on its own has three distinct elements which acknowledge the three other forms of scholarship: the synoptic capacity, pedagogical content knowledge (c.f. Shulman and Sykes, 1983), and what we know about learning.

Many researchers in the field of SoTL have argued the importance of a combination between research and teaching in academic work. For example, Bender and Gray (1999) argued that the scholarship of teaching describes a new concept of academic work which begins in the classroom where the learning is happening. In this way they saw scholarship of teaching as collaboration between teachers and students and meeting one another in 'ever-wider circles'. But they also emphasized the importance of the fact that "Teaching like other forms of scholarly work, must not only be reflective, systematic and replicable, but public" (Bender and Gray, 1999, p. 2).

Then, more recently, some researchers of SoTL have started to investigate and characterize how university lecturers act in their practice setting and, as Kreber (2002a) suggested, ways in which lecturers can engage with their practice setting.

3.4 Good teaching

Good teaching is only a subset of SoTL and, thus, should not be confused with SoTL itself. Glassick, Huber and Maeroff (1997) argued more towards examining how good teachers should be acting rather than towards widening the concept of SoTL. They investigated how Boyer's ideas have been discussed and used at universities and they concluded that there was not enough clarity in them to inform making learning transparent, and posit the inclusion of notions of clear goals, adequate preparation, appropriate methods, significant results, effective presentation, and reflective critique into SoTL.

In a recent discussion around this issue Shulman (2000) proposed adding notions of "Professionalism, Pragmatism, and Policy" (Shulman, 2000, p. 49). He used the notion of professionalism to draw a sharp distinction between "scholarly teaching" and SoTL. In so doing he argued that scholarly teaching was an activity well grounded in the sources and resources appropriate in the field and should integrate ideas, strategies and examples to develop course design and assessments. The scholarship of teaching included scholarly teaching, but the work must become public, peer-reviewed and critiqued, and exchanged with colleagues so they can build on the work.

3.4.1 Embedded in teaching practice

In the USA, the home of SoTL, encouragement and support have been widely provided by The Carnegie Foundation for the Advancement of Teaching. Their focus is primarily on the teachers as practitioners and their struggle to embed their practice in SoTL. Example of support are given on their web-site, where lecturers emphasize their struggle to elaborate and evaluate teaching and learning processes. Just to mention one example, a lecturer Bass (1990) has written about his experience of development as a scholarly teacher. It was very interesting to read his story where he describes his knowledge development. The way he worked with problems in the education situation and the way he reasoned around the problems he and his students bumped into are very revealing. They illuminate how a teacher can engage practically and intellectually with reflection and student-teacher interaction to improve learning. Such experiences raise the question about, 'how different disciplines bring rules and assumptions about what constitutes credible evidence, and what kinds of methods yield scholarly results'. Out of this, a question arose that was fast attracting wider and wider interest in the higher education community: 'How can lecturers from different fields and traditions communicate in an efficient way in matters of scholarship of teaching and learning?'.

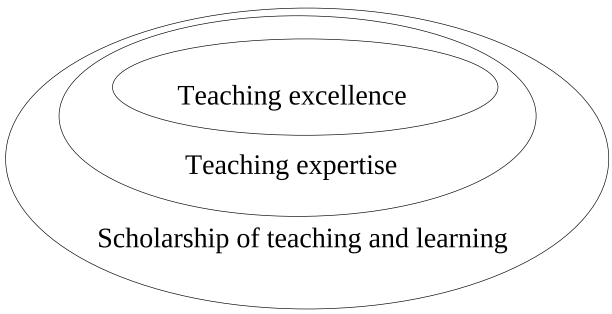

Figure 2: Excellence and scholarship (figure from personal communication with Keith Trigwell)

Another question is 'Are all lecturers supposed to do what Bass has done or is less enough?'. Kreber has written two articles (2002a, 2002b) which build on Boyer's report (1990) "Scholarship reconsidered" and Trigwell's et al. (2000) article "Scholarship of Teaching: a model" in an attempt to clarify the meaning of excellence in teaching, expertise in teaching, and the scholarship of teaching, see Figure 2. In the first article her emphasis was on giving lecturers a language to use in assessing teaching. In the second article Kreber discussed teachers' ideas of what was meant by scholarship of teaching and she concluded that not all academic staff should be required to make the scholarship of teaching the focus of their career. But,

> ... we need to be careful not to advocate a model of the scholarship of teaching which leads to an undervaluing of teaching excellence in our universities. In practice, therefore, distinguishing between the two makes sense only if each is eventually considered in its own right and valued in its own right, and not by comparing the two to each other (Kreber, 2002b, p. 19).

The study by Trigwell and colleagues (2000) crafted out a SoTL model based upon theoretical arguments from the literature and from their own empirical analysis of teachers' conceptions of SoTL. Their results described four dimensions of SoTL, namely:

> (a) being informed about teaching and learning generally and in the teachers' own discipline, (b) reflection on that information, the teachers' particular context and the relations between the two, (c) the focus of the teaching approach adopted, and (d) communication of the relevant aspects of the other three dimensions to members of the community of scholars (Trigwell et al., 2000, p. 167).

3.4.2 Embedded in student learning

One of the most extensive efforts to include students in the conceptualization of SoTL was recently provided by Trigwell and Shale (2004). They depicted teaching in terms of a reflective and informed act in a transaction with students. They created an analogy to capture this transaction as "pedagogic resonance" to capture the bridging nature between teachers' knowledge and students' learning.

3.5 The notion of disciplinary styles in scholarship of teaching and learning

A new development in SoTL is the notion of disciplinary style. The notion of a SoTL disciplinary style is based upon the idea that all disciplines have their own epistemic ways of reasoning, validating results, making claims, choosing appropriate methods and their general approaches to teaching and learning (Huber, 1999). Huber and Morreale (2002) looked at different disciplinary styles in SoTL in a book 'Disciplinary styles in the scholarship of teaching and learning'. Here they brought out teachers' concerns about the status of the work in SoTL in their own field at the universities where they taught. They argued that it was important to situate SoTL within the different disciplines and to create "trading zones" (Gallison, 1997, pp. 781-884) for interdisciplinary conversations.

In the book edited by Huber and Morreale there were several illustrative stories about lecturers' approaches to teaching and learning drawn from different disciplines. These stories suggest that the social sciences use and develop SoTL theories and methods much more than for example humanities and sciences. However, there are no detailed descriptions of disciplinary styles in university physics.

4 Methodology and Method

In order to investigate how lecturers perceive their crafting-of-practice in relation to how they have come to know their students as learners, I found the theoretical framework of phenomenography most useful, and I used a general qualitative method based roughly on grounded theory (cf. Strauss and Corbin, 1994) to form categories. In this chapter a comprehensive introduction to phenomenography is presented together with a description of how the empirical data collection was gathered and analyzed. This is followed by a discussion on issues of rigour and generalization of the study.

4.1 Conceptual Framing

An introduction to phenomenography

Phenomenography provides an epistemology and method for investigating and describing different ways of experiencing or conceiving phenomena in the world (Marton, 1981, 1986). This research approach was developed at the Department of Education and Educational Research at Gothenburg University, Sweden, in the mid-70s when investigating learning from students' perspective. The research was led by Ference Marton and the emphasis was on how the students experience learning. The phenomenographic theoretical tradition's main point is that it is firmly formulated within a non-dualistic world view that posits that what is termed experience is created or, rather, constituted as a relationship between the individual and the phenomena making up the world we live in. Put another way, knowledge is independent neither of a person nor of the world the person lives in, it is rather the relationship between the person and the context.

Phenomenography is concerned with investigating qualitatively different ways of *what* and *how* things are experienced. This is a second order perspective rather than a first order perspective. In a first order perspective the researcher is aiming to describe the phenomenon as perceived by him or her. In a second order perspective the researcher forms descriptions on the basis of how others describe their experience of the phenomenon.

The focus of phenomenographic research is

> ... on mapping variation in experience, in terms of the range of qualitatively different ways of experiencing particular phenomena and structural relationships between the different ways of experiencing (Åkerlind, 2003, p. 45).

This results in collective experiences which are presented in an 'outcome space' from which the researcher constructs 'categories of description'. The categories are logically related to one another and often there is hierarchical structure to the categories.

The outcome space is representing a range of possible ways of experiencing the phenomenon. The researcher can never capture the full range of key aspects or ways of experiencing a phenomenon in the human population. The categories of description are derived from the collective data, not from individual persons. The individual is seen only as contributing a fragment of data to a given category of description. There is, however, often a variation in ways of experiencing a phenomenon, not only between persons but also within a person. The variation in the outcome space is referred to as the dimension of variation, and the phenomenographic approach focuses on the key aspects of the variation in the ways a phenomenon is experienced.

4.1.1 Why phenomenography?

Phenomenography is widely used to investigate lecturers' ways of understanding teaching (*e.g.* Prosser, Trigwell and Taylor, 1994; Trigwell et al., 2000; Åkerlind, 2003). I have not looked at the actual teaching, but at how lecturers experience their teaching in relation to how they see their students as learners. I have focused on

> ... an internal relationship between the person experiencing and the phenomenon experienced: It reflects the latter as much as the former. If awareness is the totality of all experiences, then awareness is as descriptive of the world as it is of the person. A person's awareness is the world as experienced by the person (Marton and Booth, 1997, p. 108).

The aim of this thesis has been to find qualitatively different ways that physics teachers craft their practice. It has been central to explore the lecturers' way of perceiving their relationship with themselves as teachers and with their students as learners. I have looked for the variation across lecturers, not a particular variation between individual lecturers or within one lecturer.

4.1.2 Other paradigms

There are several different paradigms one can use to investigate the general question how lecturers craft their practice as teachers, such as case study, discourse analysis, situated cognition, cognitive science, phenomenological observational sciences of human behavior, resource based view etcetera. Because of the nature of my research question I chose between two different paradigms, situated cognition and phenomenography.

Situated cognition's main feature is that it characterizes learning as a social practice,

> ... learning involves the whole person; it implies not only a relation to specific activities, but a relation to social communities - it implies becoming a full participant, a member, a kind of person. In this view, learning only partly - and often incidentally - implies becoming able to be involved in new activities, to perform new tasks and functions, and to master new understandings. Activities, tasks, functions, and understanding do not exist in isolation; they are part of broader systems of relations in which they have meaning (Lave and Wenger, 1991, p. 53).

To study lecturers' crafting of practice one could argue that social practice would be particularly important. Several researchers in situated cognition argue for the interdependence between activity, concept and culture in learning. Brown, Collins and Duguid (1989), for example, claim that

> To learn to use tools as practitioners use them, a student, like an apprentice, must enter that community and its culture. Thus, in a significant way, learning is, we believe, a process of enculturation (Brown et al., 1989, p. 33).

However, my aim has been to capture the variation in lecturers' crafting of practices. Thus, to describe qualitative differences in the experience of the crafting of lecturers' focuses in perception of teaching practice - how lecturers perceive themselves as lecturers vis-à-vis the role played in making student learning possible. My study is phenomenographically based in terms of its research approach and, therefore, the descriptions produced are taken out of their context. But at the same time Brickhouse's (2001) situated cognition argument has firmly underpinned my idea of crafting being situated in a teacher's conceptual framing:

> ... learning is not merely a matter of acquiring knowledge, it is a matter of deciding what kind of person you are and want to be and engaging in those activities that make one part of the relevant communities (Brickhouse, 2001, p. 286).

This conceptual framing incorporates pedagogical content knowledge, the educational environment and knowing students as learners.

4.1.3 How phenomenography is typically used

The most common form of data collection in phenomenographic studies is individual interviews, where the aim is to encourage interviewees to reflect on their own experience (Entwistle, 1997) and to articulate their awareness of, or ways, of understanding the phenomenon (Bowden, 2000). These interviews are normally semi-structured, meaning that the interview schedule consists of a small number of planned questions. The majority of the interview, however, is spent on follow-up questions to encourage further clarification of the interviewees responses. The aim is to keep asking for further clarification until the interviewee's understanding appears clear.

Phenomenographic interviews are normally recorded and transcribed verbatim. The analysis starts with trying to find meaning or variation in meaning across the interview transcripts and to search for the structure and meaning of the experience. Reading through the interview transcripts calls for a high degree of openness to possible meanings. This is an iterative process involving sorting and resorting of transcripts when developing categories of description according to perceived similarities and differences along varying key concepts; "categories are tested against the data, adjusted, retested, and adjusted again. There is, however, a decreasing rate of change and eventually the whole system of meanings is stabilized" (Marton, 1986, p. 43).

4.2 Method

In this study I carried out semi-structured interviews with 13 physics lecturers at two universities in Sweden - a newly established university college and a long established traditional university. The aim with the data collection is to gain a maximum variation in the ways of describing crafting-of-practice. With that purpose in mind I chose well experienced lecturers of different sexes, ages, orientation in the subject physics and rank at the department. The semi-structured interview is based on a set of predetermined questions with an open structure (see Appendix A). I tried to vary the focus of the interviewee's awareness and reflection (on unthematized aspects of their teaching and learning environments). The typical kinds of questions were structured around issues of how lecturers saw themselves and how they perceived their students saw them as lecturers. I encouraged each interviewee to reflect on aspects of teaching and learning in their teaching environments and to explain or elaborate on what she or he had said earlier. See Appendix B for a full interview example. The interviews were recorded and transcribed verbatim.

4.2.1 Data analysis

The central part of the analytical approach is the relationship between the parts and the whole of the constitution of lecturers' practice. I started out with a search for meaning and structural relationship across the transcripts. I cut out more important parts of the transcripts into quotes. The quotes were grouped and regrouped according to perceived similarities and differences along varying criteria. The criteria used were based on the qualitatively different focuses the interviewees seemed to have had, for example toward themselves as teachers or subject experts, the students as persons, group members or learners, or pedagogical theories etcetera. The iterative grouping and regrouping were helped by my coloring the transcripts in certain colors for certain criteria. Thereafter, I cut those particularly colored parts out of the transcripts and put them into 'color-stacks'. Some parts of the transcripts may have several colors and are, thus, put in several 'color-stacks'. Out of this iterative sorting (and re-sorting) process, coloring, use of different perspectives, and comparison between data, a set of categories and meanings emerged. The criteria used to sort the quotes became more and more specific during the iterative process. When the resorting of the quotes was almost done and new and more complicated quotes could be sorted into the existing categories I found a result established. The issue of quality of the result will be discussed below in more detail.

When, finally, I was satisfied with the categories of description I tried to find a logical structure between the categories. To achieve this I searched for logic and inclusive relationships between the categories. I used this process when searching for inclusiveness among the categories to generate a logical hierarchy amongst the categories: this is a scale of a more or less intellectually and pragmatically developed view of teaching and learning.

In order to understand and resolve mismatches and inconsistencies in my interpretations I discussed my interpretation of certain transcripts with two of my colleagues. By verbalizing my understanding and listening to my colleagues' responses, I was able to explore the transcripts in broader ways and to gain a more variable outcome space.

4.3 Quality issues for qualitative research in general

In qualitative research work it is important to pay attention to issues of quality and rigour. Quantitative researchers

> ... use mathematical models, statistical tables, and graphs, and often write about their research in impersonal, third-person prose [qualitative researchers use] ethnographic prose, historical narratives, first-person accounts, still photographs, life histories, fictionalized facts, and biographical and autographical materials, among others (Denzin and Lincoln, 1994, p. 6).

In qualitative research the researcher is required to "persuade his or her audience (including self) that the findings of an inquiry are worth paying attention to, worth taking account of" (Lincoln and Guba, 1985, p. 290). Traditional qualitative methods typically address the following issues:

1. *"Applicability: How can one determine the extent to which the findings of a particular inquiry have applicability in other contexts or with other subjects (respondents)?"*

2. *"Consistency: How can one determine whether the findings of an inquiry would be repeated if the inquiry were replicated with the same (or similar) subjects (respondents) in the same (or similar) context?"*

3. *"Neutrality: How can one establish the degree to which the findings of an inquiry are determined by the subjects (respondents) and conditions of the inquiry and not by the biases, motivations, interests, or perspectives of the inquirer?"*

4. *"'Truth value': How can one establish confidence in the "truth" of the findings of a particular inquiry for the subjects (respondents) with which and the context in which the inquiry was carried out?"* (Lincoln and Guba, 1985, p. 290).

These issues are widely known as 'internal validity', 'external validity', 'reliability', and 'objectivity'. Qualitative researchers address these issues through the notions of 'credibility', transferability', 'dependability', and 'confirmability' (Lincoln and Guba, 1985).

As a qualitative researcher I do not believe it is possible to put questions to 'Nature Itself' but instead believe that 'reality' is a set of many experiential constructions. I must show that I have

> ... represented those multiple constructions adequately, that is, that the reconstructions (for the findings and interpretations are also constructions, it should never be forgotten) that have been arrived at via the inquiry are credible to the constructors of the original multiple realities (Lincoln and Guba, 1985, p. 296).

4.4 Quality issues for phenomenography

As a researcher using phenomenography, I have tried to describe the variation of how lecturers experience crafting their practice against a background of how they see their students as learners, *i.e.* I

> ... was making statements about the world as experienced by people. Now, in the sciences, as well as in daily life, statements are made about the world, about phenomena, about situations. These statements are made from what we call a first-order perspective. The ways of experiencing the world, the phenomena, the situations, are usually taken for granted by the experiencer; they do not see them, they are not aware of them. In phenomenography, where a second-order perspective is taken, it is these underlying ways of experiencing the world, phenomena, and situations that are made the object of research (Marton and Booth, 1997, p. 118).

And Marton and Booth continue with:

> In research context, the distinction between the first- and second-order perspectives is primarily a distinction between two kinds of objects of research. Admittedly, this gives an outrageously uneven criterion for sorting the objects of research. We have on the one hand, all the scientific research conducted over the centuries that has yielded statements about the world, the physical, the biological, the social, the cultural, which we can all relate to without recourse to a consideration of human experience. On the other hand we have a very, very small number of studies that yield statements about people's experience of the world. Investigations with a phenomenographic orientation belong to this group, along with, for instance, certain branches of anthropology, history, and philosophy of science (Marton and Booth, 1997, p. 119).

This means that I am not trying to look into the lecturer's mind, but trying to see what he or she sees. Thus, I am not describing minds, but perceptions, in other words I am not describing the lecturer, but his or her perceptual world. The aim, as mentioned before, is to "find out the different ways in which a certain phenomenon or certain aspect of reality is experienced, understood, and conceptualized" (Johansson et al., 1985, p. 250).

4.4.1 Transferability

The applicability, or generalizability, in qualitative research is a matter of transferability. The responsibility as an original investigator lies in providing sufficient descriptive data from which a person who seeks to make an application elsewhere is able to recognize context similarities in the different situations. As the original investigator it is important to demonstrate how he/she has administrated

> ... his/her interpretations throughout the research process: from formulating the research question, selecting individuals to be investigated, obtain data from those individuals, analyzing the data obtained, and reporting results (Sandberg, 1997, p. 209).

To regard the matter of transferability I have inserted quotes for every category of description I presented in the results. The quotes were aimed to give the reader the opportunity to recognize herself or himself in similar ways of crafting of practice described by the categories.

4.4.2 Dependability

As mentioned by Lincoln and Guba (1985, p. 299) "The naturalist sees reliability as part of a larger set of factors that are associated with observed changes". In other words, the inquiry depends on certain criteria chosen by the investigator in the particular study, "the naturalist seeks means for taking into account both factors of instability and factors of phenomenal or design induced change" (Lincoln and Guba, 1985, p. 299). For example, in this study the dependability consists of the interviewee's experience as a teacher and of pedagogical issues, interview protocol, following-up questions, the arrangements during the interview, the interviewer's aim with the inquiry, how the interaction between the interviewer and the interviewee works and so on.

4.4.3 Confirmability

In the issue of confirmability I will only consider determination of trustworthiness. "This stage is concerned with reaching assessments of confirmability, dependability, and, as an optional feature, providing an external check on steps taken in relation to credibility" (Lincoln and Guba, 1985, p. 323). There are several steps in relation to credibility in the assessment of confirmability. First, one has to "ascertain whether the findings are grounded in the data" (Lincoln and Guba, 1985, p. 323), and they continue with:

> Next, the auditor will wish to reach judgment about whether inferences based on the data are logical, looking carefully at analytic techniques used, appropriateness of category labels, quality of interpretations, and possibility of equally attractive alternatives. The auditor should then turn his or her attention to the utility of the category structure: its clarity, explanatory power, and fit to the data. The auditor will wish to make an assessment of the degree and incidence of inquirer bias (a clear judgment call), taking into account preponderance of inquirer terminology (as contrasted to grounded terminology), overimposition of priori theoretical concepts (believing is seeing), and presence or absence of introspections (Lincoln and Guba, 1985, p. 323).

In phenomenography issues of dependability and confirmability are firmly discussed by the phenomenographic community as follows:

> The question is frequently asked: Would another researcher working independently find the same categories and conceptions that we did? However, according to what has been said previously, we consider the finding of a category of description a discovery, and why should we require two researchers to make the same discovery independently? On the other hand, once the discovery has been made, we should certainly be able to communicate it, and other researchers should certainly be able to use the intellectual tools that are supported to be the outcome of this kind of research and be able to replicate and confirm our discovery. Consequently, what we want to ascertain is that once categories of description are made explicit, other researchers should be able to identify them when they are applicable in varying contexts. In accordance with this, indicators of reliability should not concern the extent to which categories are discovered independently, but the extent to which they are identified once they have been specified (Johansson et al., 1985, p. 251).

4.4.4 Credibility

When considering credibility I presented the categories of description I found in my data to the members of my research group. In that way I was able to consider many of the substeps which Lincoln and Guba suggested (see p. 323, 1985). First I presented the categories and afterwards I handed out several quotes from each category and asked my colleagues to sort them into the developed categories. They worked independently with the quotes and the categories to see if they would be sorted back into the categories which were built on them. When they had finished we went through every quote and discussed how they had picked out a suitable category for each quote. It turned out to be a high agreement between my way of forming the categories and my colleagues' way of sorting the quotes into these categories. The sorting of the quotes which we did not agree on resulted in profitable discussion, which tuned my formulation of the categories. In the discussion of categories we, my colleagues and I, were also able to see a logical hierarchical structure among the categories. We considered whether some of the categories included criteria of any other category. For example, if one of the categories has pedagogical content knowledge as a criterium, categories which have discipline knowledge and technical aspects of presenting information as criteria are inclusive in the first criterium.

5 Results

Using the parts of the phenomenographic research approach (Marton and Booth, 1997) that focus on capturing the variation in experiencing phenomena bringing out the qualitative variation, I conducted 13 interviews with physics lecturers working at two Swedish universities. During the discussions I looked for characteristics of pedagogic reasoning and pedagogic resonance to explore with the interviewees. I did this exploration by situating the discussion around actual physics teaching episodes and the lecturers' broad teaching and learning insights and concerns. During these interviews I explored how the lecturers formulated, and how they reflected on and put into practice the conditions that they felt made learning possible. They were also asked to describe how they saw their students' learning take root and grow, how they saw themselves as teachers, and how they thought that their students saw them as teachers. Issues such as goals and what motivated certain thinking and teaching initiatives were also discussed. These interviews were recorded and transcribed verbatim. The analysis to obtain the variation in meaning involved an iterative but non-algorithmic data sorting process to group and re-group different pieces of data until saturation was achieved. The final outcome was the formulation of five qualitatively different categories of ways of crafting university physics teaching practice. These are outlined below, and a summary of the variation characterized by the categories – the structure and meaning of the categories – is given in Table 1.

5.1 Categories of description

From the transcripts of the 13 interviews a variation of understandings was captured from which I formulated five qualitatively different approaches to how lecturers craft their practice, which constitutes five categories. The central part of the analytic approach was to look for the relationships between the parts and the whole of the constitution of lecturers' practice. The quotes were then sorted to capture qualitative differences in the experience of the crafting of lecturers' practice. The categories reflect qualitatively different focuses in perception of teaching practiced - how lecturers perceive themselves as teachers vis-à-vis the role they played in making student learning possible. Issues such as goals and what motivated certain thinking and teaching initiatives played a fundamental role in the category formation. The categories are hierarchical with higher order categories being more complex than lower order. The five categories of description that emerged are:

A: Practice founded on techniques for presenting.

B: Practice founded on presentation of the content.

C: Practice founded on intrinsic gratification.

D: Practice founded on shaping of environment.

E: Practice founded on student engagement.

The outcome of this investigation is mapped in Table 1, but also described and illustrated below with quotes from the interviews. The quotes are from relevant interview transcripts but it is impossible to cover the fullness of a category from such quotes . However, each quote is aimed at enriching the reader's understanding of some of the characteristic features within a category. It is also worth noticing that it would be possible to categorize a lecturer in one or more categories, but such classification does not form part of this study. All quotes are translated from the original Swedish.

How is practice construed in relation to presuppositions about students as learners?			*What is the intention of the practice?*	
Category of description - Practice founded on	**Background to description**	**What descriptions focused on**	**Orientation**	**Meaning**
A: Techniques for presenting	Professional job	Technical aspects of presenting information	Self	Being competent in presentation
B: Presentation of the content	Discipline knowledge	Enactment of knowledge creation	Students as observers	Formulating good images to represent knowledge for transmission
C: Intrinsic gratification	Pedagogical content knowledge	Personal development	Students as consumers	Gaining more content knowledge about the discipline and students
D: Shaping of classroom environment	Pedagogical content knowledge from lecturers' perspective	Formulating a positive and interacive learning environment	Students as people	Creating a positive learning experience
E: Student engagement	Pedagogical content knowledge from students' perspective and knowing students	Formulating a range of learning engagements	Students as learners	Creating a positive learning engagement

Table 1: Analysis of variance of how university lecturers of physics craft their practice

5.1.1 The categories described in detail

A: Practice founded on techniques for presenting
This category focused on teaching techniques and on systemizing the discipline; it is the lecturer's job to make learning possible. The orientation is towards themselves as lecturers and how well they master the technique to present the key concepts in physics. The descriptions include issues like what kind of equipment is most powerful to show the audience interesting phenomena which they can relate to later in other descriptions. For example,

> Well, I actually use the blackboard nowadays..., quite a lot. I haven't really started, or rather I did, I worked with computers, shall we say about 3, 4, 5 years ago, but I really don't think you gain anything. It takes time you know, [...] set up the computers and projector and everything to show some oscillation with Matlab or something, and that's fine. But if you add up the time 'n what you gain in what gets across..., well it becomes a lot then with computers OK you get a nice background color and nice fonts 'n everything and maybe even an animation 'n it looks good. But what was the value, ehh, what got across? But I got just the same message across in half the time using plain chalk, well I think chalk is unbeatable.

This quote showed a concern about what technical support might be of best benefit to the lecture, the discipline and in some sense the audience. The lecturer has tried different kinds of equipment and found out what suites best. Another interviewee paid attention to help with the structuring of the discipline for the students,

> The teacher is..., naturally invaluable during the first years. "Read this!", "Read that!", "Do it this way!" How should you think about this, how should you think about that, and so on so that it leads to rational thinking, so you don't get it wrong.

The focus is strongly directed towards the lecturer as a professional physicist being able to show the best way of structuring the phenomenon which is taught, which means that the students are presented with a way to understand the phenomena. The above quotes illustrate the dominant approach in this category of description: it is a lecturer's job to be competent as a presenter of the discipline and phenomena. In other words, the descriptions were focused toward teacher transferring knowledge. The "technical rationalism" (Schön, 1983) expressed considers black-board-technique, the use of computer-simulations of a special phenomenon, what equipment the student may use at laboratory classes etcetera.

B: Practice founded on presentation of the content

In this category the discipline content taught in a course was of greatest importance. Often the experiences depicted an emphasis on creating good images to represent knowledge for transmission. The most important part of teaching is the discipline and how to interpret the discipline content. My interpretation was that the argument implied that a good way for a lecturer to strengthen his/her argument is to refer to formulae, thus making it even more abstract, even though the intention is to make it more transparent for the students. For example, the quote below shows a great concern about the discipline and the lecturer and far less about the students:

> It is very important that you feel what you want them to take away with them - knowledgewise that is. All the rest is just communication, two - in some way - two different planets that you have to move around on at the same time. It's partly the communication and all this in some way personal stuff, and then the actual subject, I mean the subject is really the most important thing.

Discussions between lecturer and students were of not of great importance, instead the focus in this category was on making the content knowledge available to students, to describe physical situations as simply as possible. Another aspect which was well articulated was the aim to obtain details of students' pre-knowledge to form a 'knowledge-platform', which lecturers can use as a starting point in their descriptions and analogies. For example,

> Lecturer: Show some more examples maybe..., and so, so you create a, a strong, eh platform for everybody. A physical platform where you stand and feel safe, you know.
> Interviewer: Mmm
> Lecturer: You show the way you should look at things. Erm, all, all students should know what the platform is.
> Interviewer: Mmm, the social platform you mean?
> Lecturer: No, the physical platform.

Descriptions within this category have a focus on guiding students in knowledge of physics.

C: Practice founded on intrinsic gratification

This category was characterized by descriptions in terms of self-development in personal terms and in terms of knowledge of the discipline. In some sense there was recognition of getting to know their students as learners. For example, it is considered important to know how students learn physics, how you as a lecturer can communicate physics with the students and appreciate students' knowledge of the discipline and surrounding disciplines. Below is a nice description from a lecturer who had to change his understanding of certain a phenomenon:

> Lecturer: All these years I've been making a mistake with a helium balloon. I've always given them the opportunity to breathe in helium to see if the frequency gets higher.
> Interviewer: Yes.
> Lecturer: And then, I have thought! Because you've got these examples, these standard examples pipes and strings. If you have a string it won't be affected by the medium, but if you have a pipe the medium will control the frequency.
> Interviewer: Mmm!
> Lecturer: And I have seen this as a picture of, eh, the throat is the generator of the frequency and the vocal cord doesn't matter very much, it's not the vibration that matters so much. Last year, though, one of my students studied opera.
> Interviewer: Wow!
> Lecturer: And it didn't match up with what he had learned! He could feel when the note formed. And then you have to think a bit more about this.
> Interviewer: Right.
> Lecturer: Because then, I mean the answer, the answer seems, when we went further and looked at this, that, that the throat gets like that when it amplifies, when the notes really are generated by the vocal cords, but that, eh, the overtone is what is amplified by the throat.
> Interviewer: Yes...
> Lecturer: Well, it's not really the note that changes, it, it's really the resonance.
> Interviewer: Which notes we hear...
> Lecturer: Yes, so it's really the first overtone that gets higher...
> Interviewer: I see!
> Lecturer: So it's not the sound speed that changes it's only the result that becomes different.
> Interviewer: I see!

> Lecturer: Yes..., and I have taught it wrong all these years. And that feels quite embarrassing but on the other hand it's important that I started to think about it, right?!
> Interviewer: Yes.
> Lecturer: So in a way it doesn't feel that awful....
> Interviewer: No..., no!
> Lecturer: Hehe! And really. Because it's, it's really the way I think. I mean, from my standpoint I hear the frequency changing, but if it was a string, then there'd be no difference, and that's still true, right. The reasoning's still OK, it is just that the observation.

This category was also characterized by the fact that the experiences presented were always pointing outwards from the lecturers themselves. The descriptions originated from lecturers towards the students, very rarely the opposite way.

Another dimension of this category was the belief lecturers have about being accessible as a resource-bank for the students. They really want to appear as 'a nice guy' whom the students can ask all kinds of questions. But as lecturers they are still the central figure in the teaching situation.

> One of the things is to help the students to teach themselves, that's what i's all about. So structuring has been guiding rule for me for a long time, up until the last ten years when I started to teach trainee teachers more as well, the method has changed, right. In the past I've tried to be as easy going as possible, be relatively friendly, tried to structure as well as possible and make complicated things seem easy.

D: Practice founded on shaping of classroom environment

The focus in this category has changed from previous categories, which were lecturer focused, towards a more "student focused" (Prosser and Trigwell, 1999) view. The descriptions were characterized by concern of shaping a social environment in which students hopefully can feel less inhibited and contribute to fruitful discussions. The aim is to create a 'friendly' atmosphere where the students freely can pose questions and arguments, to get an interactive discussion going. In the descriptions, the focus was on the students as a group; how they behave, what they ask, how they respond to questions from the lecturer, invite individuals who are outside the frame of the course and so on. For example,

> Without having a social platform, you will never have a good physical one either. Since, eh, the lessons must be, as I see it at least, very free, so you, ehm, you should dare to ask your questions without thinking "That's a really stupid question, I don't dare to ask it", "Oh, this is an even more stupid question and now I am disturbing the lesson" and so on.

All of this must be built on a relationship between the lecturer and the students according to the experiences of the lecturers, and the only way to a relationship is to have a dialogue. In the work of creating such a 'comfort zone' there are some particular strategies mentioned, namely knowing students by name, taking pictures of them, making eye-contact, talking to students after lessons, asking for students' opinions about the teaching, using humor, etc. Some lecturers have put forward a slightly different way of creating a nice social environment for the students by trying to not show the students what they really feel about the students' questions and remarks. The quotation below is a good illustration.

> But you have to be prepared for all kinds of silly questions and you can't show that you think the questions are silly. [...] You can always go to your own office and pull your hair out later but in the classroom you can't let it show.

E: Practice founded on student engagement

The experiences making up this category were about in what ways students are engaged in learning and how different situations affect present learning styles and learning outcome. By knowing the students as learners the lecturers are better prepared to maximize student learning possibilities. This kind of practice is based upon an epistemological belief that students best can learn from interactive teaching. The interaction can be formed in two different ways which I will call themes.

One of the themes was built on a quasi-constructivist view of learning. The descriptions emphasize the attempt to create a situation for the students that is a bit chaotic. The aim of the approach is to encourage the students to formulate their own knowledge and world view. The activity should be among the students, the lecturers' role is to give tasks or paradoxes with which the students can engage.

The other theme recognized differences in how students' learning takes place. Students are not one homogeneous group of people, instead they are viewed as individuals. Students all think and argue differently. It is important to get to know your students as well as possible as learners but also at a personal level. This theme contained a social-cultural way viewing of the teaching.

> Well, of course everybody think in somewhat different ways... [...] if you don't consider that when you teach you get some middle-way teaching where those who think very differently in either direction so to say, or all directions, get into difficulties. But if you on the other hand make it more individualized, then different aspects appear that you might not have thought about otherwise.

6 Discussion

In previous chapters I have outlined my reasons for investigating the variation of how physics lecturers craft their practice in terms of how they know their students as learners in order to make learning possible. Briefly, I argued that such a study opens up new potential for broadening the understanding of the notion of the scholarship of teaching and learning (SoTL). In this chapter I will discuss the results from a teaching perspective, a learning perspective, and a SoTL perspective.

6.1 From a teaching perspective

The five categories described delimit qualitatively distinct ways of how physics lecturers craft their teaching practice in a physics teaching context. Each category is characterized by distinctive attributes (presentation, content knowledge, personal development, social environment, and students' engagement), but our data analysis indicates that there are some overall aspects that cut across the categories and seem to be common to all or most of them. Here two important aspects emerge.

The first aspect is the orientation that being a lecturer is something that must be crafted: the practice of making learning possible is a creative activity. There are always possibilities to become better at what you as a lecturer do in a teaching situation. Although the descriptions contain very different focuses in what one can develop, creation of meaningful teaching situations is still a very important aspect. The crafting focus in the lowest category of the hierarchy is towards oneself, as a lecturer, and how one's technical skills may be developed. Further up in the hierarchy, the aspects are focused on personal skills, relationship to students, students as learners and pedagogical content knowledge. Most striking, but also comforting, is the fact that the descriptions hardly contain a view of stagnation in the creation of their profession. Perhaps this is negative, but I had expected that a majority of the lecturers would show the spontaneous attitude that it is not necessary to have any development in their practice.

The second aspect is the lecturers' relationships with the students. In all the categories except the first, relationships with the students are pronounced. It was very interesting to learn how the lecturers approached students as a group of people, students as a group of total strangers with whom you are not sure you want to get too close to, and students as individuals with different needs and approaches to the discipline and learning. In many cases there were differences in how the lecturers described their view of, for example, an ideal lecturer and what they expected the students to think. This I think, in some sense, reflects an ongoing reconsideration of relationship with the students. Many of the descriptions contain stories which describe a conscious refocusing in their way of getting in contact with the students and how they could use that contact to develop themselves as lecturers and within the discipline.

6.2 From a learning perspective

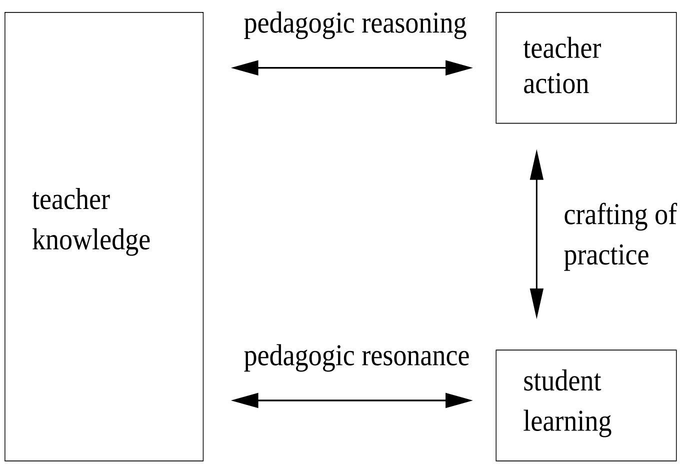

Figure 3: The relations between teacher knowledge, teacher action, and student learning in terms of pedagogic reasoning, pedagogic resonance, and crafting-of-practice

In Figure 3 the relationships between lecturers and students are sketched. Here I have drawn on the work of Trigwell and Shale (2004) and Prosser and Trigwell (1999) to look at the relations between teacher-knowledge, teacher-action and student-learning. From a learning perspective the most important relations are pedagogic resonance and crafting-of-practice that represents the part of what students experience in the act of teaching and which contribute to their potential to learn. This can be seen as a metaphorical teacher-learner bridge that attempts to capture what takes place within the dynamics of successful interactive teaching. In a recent study (Dominicus et al., 2005) we conducted an analysis that illustrated how lecturers' crafting-of-practice could significantly be influencing how students come to think about quality teaching.

> The results of the study suggest that the ways that teachers craft their practice - meaning the formulation of patterns of teaching in terms of a particular conceptual framing, which is considered to best optimize learning possible - is related to influencing the ways that students develop as learners. [...] The study thus offers additional support for the view that university lectures can best optimize their attempts to make learning possible if they craft their teaching practice more around engagement with students (Dominicus et al., 2005, p. 10).

The results from our study (Dominicus et al., 2005) and this licentiate thesis point towards research on the interactive process between lecturers and students. I believe results from such studies could contribute to a broadening of the understanding of the notion of SoTL in the university physics.

6.3 From a scholarship of teaching and learning perspective

One could say that in order to be able to be a good teacher a lecturer has to be intellectually involved in his/her discipline and teaching to be able to prepare dynamic analogies, metaphors, and visualizations etcetera. Teaching should promote learning and encourage students to be constructive in their criticism. And lecturers who take a scholarly approach should see their teaching as a learning experience of the content, pedagogical content knowledge and their students as learners (Marton and Morris, 2002). Thus, one could say that the aim of university teaching is to make learning possible (for example, see Ramsden, 2003) within the taught area. The aim of the SoTL is about making transparent how learning is made possible (Trigwell et al., 2000) through the crafting of teaching practice. Thus, lecturers' practice should be made available for public critique so the whole community can acquaint itself with the teacher's craftsmanship and develop the teaching and learning practice.

The background descriptions, intentions and orientation of the teaching practice vary significantly between the categories developed from my data. The most plausible reason for this variation, as I see it, must be the two aspects mentioned above: central development and relationship with students. And because these aspects play a central part in the descriptions I would like to suggest that this is an important part of the concept of SoTL. The concept must involve a crafting process which includes development as a lecturer (in several respects) and development of lecturers' relationships with students.

There are several articles which explore lecturers' practice in teaching in the light of scholarship of teaching, for example, (Trigwell and Shale, 2004), (Trigwell et al., 2000), (Kreber, 2002b), (Kreber, 2002a), and (Huber and Morreal, 2002). The articles focus on the activity a lecturer should take to be viewed as scholarly. In contrast, I have focused on the ways physics lecturers experience crafting their practice in terms of their students as learners and formulating pedagogical content knowledge. I feel that, as Boyer suggested, the scholarship of teaching is more than a set of "rules". It is a way of understanding the connection between practice, students, discipline and themselves as individuals - all closely related. Thus, I argue that adding crafting-of-practice to 'pedagogic resonance' and having a interactive process with students should be seen as an integral part of the scholarship of teaching. And, as mentioned earlier, their crafting-of-practice should be public so their colleagues can take part in the teaching process.

7 Future research

In my future research I will continue to work from the perspective that university teaching is essentially about making learning possible (Ramsten, 2003) and that the scholarship of teaching and learning (SoTL) is essentially about making transparent how such learning is, or has been, made possible. I have already begun a study (Dominicus and Linder, 2005) exploring the way in which the "disciplinary style" (Huber and Morreal, 2002) of university physics shapes the SoTL.

Recently, work has begun to explore the nature of how SoTL manifests itself across disciplines (in the mainstream scholarship of those disciplines). The variation of manifestation of SoTL has become known as disciplinary style. This notion of disciplinary style incorporates physics discourse, methods, concerns and values, and the ways of understanding connections between practice, student learning, and teachers themselves as individuals and as part of a discipline-based community. A disciplinary area not yet explored for such disciplinary style is the university physics teaching and learning environment, which principally consists of higher level physics lecturing, problem-solving and conceptual exploration tutorials, and laboratory work. I have started such disciplinary style exploration. This is done by describing and discussing an exploratory investigation into the kind of relationship that there may be between what I have called the crafting-of-practice in university physics and what Ashwin and Trigwell (2004) have called the levels of pedagogic investigation that teachers may undertake in relation to personal, local and public knowledge profiles.

The characterization I have begun to build for the SoTL disciplinary style of university physics captures elements of physics lecturers' teaching discourse, reflection, how they view their students as learners, and how they may share this knowledge for critique, and for further development. In order to start the exploration I have performed new interviews with physics lecturers at five different universities in Sweden. I have looked for relations that emerge between what I have captured as crafting-of-practice and an associated level of what Ashwin and Trigwell (2004) have characterized as pedagogical investigation.

A preliminary and interesting outcome to emerge was that lecturers who craft their practice around conceptual frames supported by interactive teaching are the ones who appear most likely to engage in some kind of SoTL activity. Practice that is supported by characterizations of teaching technique, ways of presenting knowledge, and intrinsic gratification appears less likely to engage in some kind of SoTL activity. Yet, it is my experience that it is within these categorizations that recognition for quality university physics teaching is often constituted. I can also see a model of university physics disciplinary style to emerge, suggesting that the disciplinary style embedded in the mainstream scholarship of physics could be a discouragement to the SoTL activity - the mainstream of the community already 'knows' how best to organize teaching.

Results of this initial study indicate that research to adequately capture the nature of this disciplinary style would be interesting. For example, it is my experience that a large part of the university physics community regards itself as being a highly competent, creative and intelligent academy of scholarship. Consequently, one part of the resultant disciplinary style appears to discourage 'admitting' that one is not already doing a good teaching job, while another part values new insights and interests associated with any scholarship. Both manifest in the extreme the spirit of teaching independence and pride that I see emerging from the mainstream scholarship of university physics. Thus, this raises questions around the disciplinary style of physics. For example, exploring the kinds of relationships that may emerge between how physics lecturers see physics as a discipline, themselves as physics researchers, themselves as professional teachers and the kinds of teaching categories I have used for this report. In such study I would use Brickhouse's (2001) situated cognition argument.

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A Interview questions

1. Can you tell me how you work as a teacher in broad general terms?
   (a) Number of lectures, lessons, seminars, laborations, etcetera?
   (b) Number of courses, students, teacher-assistants?
   (c) Describe your approach/preparation for lectures, lessons, seminars, laborations, etcetera.
2. Can you describe your view of yourself as a teacher and how you believe your student views you as a teacher in terms of:
   (a) What is most important to you?
   (b) What do you consider when you prepare a class/course/exam?
   (c) In what ways do you know your students?
   (d) What is your relationship with other lecturers, how would you like it to be?
3. What is your picture of a good teacher?
4. What do you think your students' picture is of good physics teaching?
5. What is your view on your students in physics?
   (a) Are there different levels between students and how do you distinguish between them?
   (b) How do you think your students learn physics?
   (c) How would you like it to be?
6. In what ways do you communicate with your students?
7. How do you know that the students are learning what you want them to learn?
8. In what ways are you trying to bridge the knowledge-gap between you and your students?
9. Can you describe to me what you consider when you want to improve your teaching? How do you take these ideas into account in your teaching practice?

10. As a university physics lecturer people would describe you as a scholar - how do you see the meaning of the word for yourself?
    (a) Do you see it as applying to your teaching?
    (b) How would you like to describe the most important qualities of a scholar person?

B Full interview example

I: Mmm, okej. Emmmm, när du har undervisning, vad har du för typ av undervisning? Är det föreläsningar å så'nt eller...?
L: Ja det kan det vara, föreläsningar och lektioner, det skiljer man ju på på ingenjörsutbildningarna och det gör jag också. Det är helt olika saker som händer, ja, förhoppning svis. Eh, på andra kurser, ***-kursen är det inte så utan då är det ju en undervisningssal som kan variera en hel del, det är laborationer och seminarier....
I: Okej....
L: Det är lite annorlunda.
I: Det blir projektbaserat där då eller....?
L: Projekt är att ta i, men teman, vi har teman å försöker vara tvärvetenskapliga.
I: Okej...
L: Till exempel vågor.
I: Ja....
L: Olika fenomen i naturen som kan beskrivas som vågor, det är ganska vittomfattande så det kommer dom...., fysiker, kemister till och med biologer å biovetare framförallt in.
I: Mm, kul. Ja *** har berättat lite grann om kursen, det låter jättespännande tycker jag!
L: Jo, den har gått hem rätt skapligt också tror jag.
I: Ja. Ehm, under själva intervjun här så kan väl du både ha mekanikkurserna och den här, eh, ***-kursen, kallar vi den för, i åtanke lite granna. Du verkar ha ett ganska brett spektra på hur du jobbar. Ehm, samarbete..., har du mycket samarbete med andra eller är det mest själv i.....?
L: Det är ganska mycket själv, eh, ***ingenjörerna det sköter jag ensam kan man säga. Då det gäller civilingenjörer så är det i regel så många studenter att det är flera lärare, så då är det visst samarbete förstås.
I: Slags lärarlag som...?
L: Ja, i bästa fall om man är positiv men vi tvingas samarbeta, för att få det att gå ihop, eller hur?!
I: Okej (skratt).
L: Ja om man ser det på det sättet. Däremot i ***-kursen så har samarbetet vart lite mera opåtvingat å lite mera spontant å det är..., ja en annorlunda form.
I: Ja..., ja, vi kommer in på det se'n. Ehm, om vi börjar med det här med inlärning lite grann. Kan du beskriva din syn på dig själv som lärare? Vad som du tycker är viktigast i din roll som lärare, vad du gör å....

L: Ja, jodå det har jag tänkt på. Eh, dels är det förstås att hjälpa studenterna att lära sig själva, det är väl det det handlar om. Å då har strukturering vart ett rättesnöre för min del länge, ända tills dom sista tio åren har jag börjat undervisat lärare mer också, metodiken har ändrats va. Förut har jag försökt att köra modellen mungiporna uppåt, relativt vänlig, försöka strukturera så bra det går, att, att få komplicerade saker verka enkla.
I: Mm...
L: Det har vart huvudiden. Men..., sen har ju Cedric med det här att göra också, långt innan han kom hit så läste ju vi artiklar av honom, några lärare, det är väl 10 år sedan ungefär. Så vi började tillämpa conceptual physics å..., tala med grannen å sånt här, för..., ja det är väl nästan 10 år sedan på 1-7 kurserna.
I: Mm, okej.
L: Å det försöker man ta med sig se'n också när man ser att det fungerar.
I: Ja...
L: Däremot går det inte på civilingenjörsutbildningarna än va, jag vågar mig inte på nå't så'nt där!
I: Nej....., okej...?
L: För jag har ju bara lektioner normalt. Jag är lite rädd för att eh,..., dom, dom har en inställning som är lite brutal. Man ska inte klara sig i en tenta, klart slut..., å få bra betyg då ska man öva precis på den man ska klara va.
I: Ja just det....
L: Å då tycker dom 'Ineffektivt!' kanske..., å använda dom här metoderna. Men jag har inte gjort det så jag vet inte.
I: Nej.
L: Däremot om man har en kurs som man styr själv då är det inga problem, va, då kan man göra det, va.
I: Har du provat på *** då, eller?
L: Egentligen inte riktigt men jag kör ju element av det här, jag försöker demonstrera så mycket som det går så de får se saker först innan vi går in på begreppsbildning. Å sen bryter jag alltid lektionen genom att ställa frågor så att dom får prata med varandra så att..., det kör jag.
I: Det kör du, ja... Så att det här conceptual physics för dig det är att man först tittar på själva, eh, koncepten, se'n så får dom diskutera å sen löser ni problem eller vad..?
L: Ja. Det kan man väl säga, visst, visst.
I: Jag tänkte bara vad din bild utav det hela....
L: Jo men att, att eh, om möjligt visa många, eh, demonstrationer som

är samma fenomen i grunden, va, å se'n försöka få dom att upptäcka eller återupptäcka det själva. Gör dom inte det får man hjälpa dom på vägen så att man kommer till...., rätt slutsats.
I: Ja just det.
L: Å när dom väl har gjort det så fortsätter man då och där ingenjörer dom räknar förstås, dom ska kunna räkna på mekaniska situationer.
I: Mmm, just det. En del som på TDB om jag tar det som exempel, som brukar kalla det för upp-och-ner-vänd-lärning, det är alltså, man pratar mycket om det fast bara i andra termer för samma sak som... Inte upp-och-ner att det är dumt utan upp-och-ner att man...
L: Nej..., men det är så uppenbart att man måste göra så här..., den välkände mannen, Richard Fineman, han skriver i den här boken, Q-ide, den populära varianten, om det här om babylonisk matematik kontra grekisk. Å den grekiska det är den perfekta axiomen å lemmorna-köret...
I: Ja just det....
L: Å den babyloniska var mycket praktiskt inriktad på mätproblem å annat. Jag tycker att man ska ta det här praktiska först å utveckla mot det svårare, alltså inte köra Maxwells-ekvationer från början å se'n ta detaljerna utan...
I: Verifiera ekvationerna med ett experiment...!
L: Ja, ja, nej, utan man tar den enkla varianten, startar med 1700-talets syn kanske då, å så bollar man sig framåt och sammanfattar på slutet.
I: Mmm... ehm, när du förbereder dig till exempel föreläsningar, lektioner eller labb. Är det nånting speciellt du har..., tänker på då? Som.....
L: Ja..., hur mycket ska jag ta upp är ju självklart, måste jag prata om allting eller kan dom få göra nå't själva, eh, man kan inte säga att jag måste ha så många timmar för att jag måste hinna med å säga det jag vill säga va..., utan man måste ha rimlig mängd tid för att inte krossa studenterna va, dom har ju flera saker dom också.
I: Mmm...
L: Se'n försöker jag ta då det som ska tas, vem som bestämmer det, det vet inte jag. Det är nog ganska mycket lärar'n själv fastän det finns en kursplan, det är så kort det som står där va...
I: Ja, det är väldigt luddigt.
L: Så att då gäller det att göra en grovplanering, vad hinner man med, å se'n gräver jag in mig i detaljer. Jag gräver in mig i minut för minut eller fem minuter per fem minuter på en lektion vad man ska göra, å skriver ner kort då, inte vad jag kommer å säga, för det vet jag, men vad jag kommer å skriva, visa för bilder, visa för experiment.
I: Mmm...

L: Det brukar funka å det funkar väl inom plus-minus fem minuter. Går det för långsamt då kör man på eller tar bort nå't, går det för sakta då slutar man, det är inget mer med det.
I: Nej just det, det är inget mer med det...
L: Så att struktur då, så man håller tiden, så att man inte går för fort. Man kan inte stå som en kulspruta och skriva va, det är det...
I: Nej...
L: Så att ha en sorts regel då, ha handskrivna..., glest skrivna A4-sidor med lite skiss å så där, då kan man ta 4 stycken så'na plus diverse experiment då, det hinner man med.
I: Ja..., du har ju vart med så pass länge så du har känsla för vad som funkar.
L: Jo jag har faktist, hör och häpna, det blir 35 år till hösten, ja så är det.
I: Ja, jag såg att du skulle fylla 60, ja (skratt). Ehm, om vi går tillbaka till studenterna, mmm. På vilket sätt tycker du att du känner dom studenter du har i en kurs?
L: Ja du..., jag känner dom ganska dåligt tycker jag, jag har vansinnigt svårt att lära mig namn.
I: Mmm.
L: Jag sätter mig inte å pluggar namn...
I: Nej...
L: Däremot om jag råkar på en student i en speciell situation å får se namnet, då minns jag det sen. Jag känner dom inte personligen på en 5 poängskurs, det klarar jag inte av.
I: Nej.
L: Så att, eh, inte så vansinnigt mycket personligt på så sätt. Givetvis frågar dom saker å diskuterar, men det kan man göra utan att veta personens namn, det går ju.
I: Ja! Det går alldeles utmärkt. Men skulle du vilja säga att du känner dom på något annat sätt än just personligt då?
L: Ja i vissa fall så lär man sig vilka dom är...
I: Mmm....
L: Eller hur, så är det ju?! Om dom är, ja, aktiva, passiva, sitter längst bak, om dom är villiga å ställa dumma frågor eller dumma svar till det mesta. Å man lär sig hel del också om deras förmåga efter ett tag. Det tar förstås några veckor men efter tag vet man ungefär vad dom klarar av.
I: Mmm...
L: Det gör man ju faktiskt, trots allt.

I: Skulle du vilja ha det annorlunda på nå't sätt eller...?
L: Hur då menar du, annorlunda?
I: Relationen till dom...
L: Nej, det vore kul att kunna lära sig 90 namn på ***-kursen, va, å så kunna säga Karin å så där va, men det fixar jag inte, jag kan några stycken va, det kunde vara bra men, eh, det går ändå, jag tycker inte att det är några problem.
I: Blir det en annorlunda relation till dom hära..., studenterna i ***-kursen än traditionella civilingenjörskursen?
L: Egentligen inte på grund av det tycker jag, möjligen på grund av dom faktiskt då är mycket öppnare än civilingenjörsstuenterna, dom är så rädda å så fega för att exponera sig för klassen. Det klart att det finns så'na på ***-kursen också men vi talar ju om för dom från början att här gäller att..., kasta ur sig allt som man har, vi betygsätter inte, å här måste vi få igång en diskussion, å dom går på det dom flesta.
I: Ja.
L: Det är annorlunda. Men jag tror inte att civilarna skulle gå på det ändå, fast man deklarerar det från början. Jag..., jag har lagt märke till att dom känner varann väldigt dåligt.
I: Civilarna?
L: Ja. När man har en kurs å ska organisera labbet, det gjorde jag här om da'n i smågrupper, å efter ett halvår så känner dom varandra ytterst dåligt, dom vet inte alls vad dom heter i en grupp på 30 personer, dom vet inte alls vad det är för några. Det är några stycken tillsammans va, 3-4 stycken som känner varandra.
I: Ja..., men inte i högre....
L: Däremot är det dom här ***-grupperna på 30, dom känner varandra på en gång!
I: Jaha!
L: Det är helt.., kolossal skillnad.
I: Ja det är ju..., faktiskt rätt intressant. Relationen till andra lärare, liksom hjälp å så där som man kan få...?
L: Ja det beror på om man sköter allting själv om man har en kurs på Ultuna å kör själv å får, då är det inte så mycket samarbete. Men om man däremot har kurs på 4 då är det självklart, då måste man ju organisera och lösa uppgifter å komma överens om vad man ska ta upp å vad man ska göra.
I: Mm...
L: Å det...., går väl bra tycker jag. Men det är inte så vansinnigt mycket tid som läggs ner på det, man är relativt effektiv då när man är gammal

i gemet då, man vet ju vad det handlar om.
I: Ja...
L: Däremot på ***-kursen har vi ägnat mycket tid åt det här då i och med att det är en helt ny kurs.
I: Mmm, har det givit nå'nting extra å ha det så eller är det liksom mest tid som läggs ner?
L: Det läggs ner en massa tid, eh, det fina är att det har visat sig fungera, det är väl det.
I: Ja....
L: Hade det inte fungerat hade man blivit ganska missnöjd. Men nu har kursen fått ganska så bra kritik då och man ska väl till och med anlägga ett *** å jag alltså, fysiken har fått bra kritik, ja.
I: Ja, roligt....!
L: Så då har, då vet man att man har satsat rätt då, för det var det svåra med det här, det var att hitta rätt nivå å försöka göra det på rätt sätt. Innan man har hållt på ett tag vet man inte alls om det går hem. Obehagligt på så sätt.
I: Ja..., jag håller med... Jag tänkte...., just det här med, när man jobbar, när man alltså känner andra lärare å har haft samma kurs, inte vet jag, säg 10 år eh, det mest.., det är kanske mest praktiska saker som man.., ja.., liksom man säger 'Ja, ska vi ta dom där uppgifterna?!', eh, å så'na saker eller diskuterar man nå'nsin problem som uppstår i kursen?
L: Ja det är mycket annat också, men det är nog mest på fikarasterna.
I: Det är mest på fikarasterna.
L: Det är faktiskt så att på fikarasterna diskuterar man mest jobbet, ytterst sällan som man snackar om någonting annat, så är det.
I: Ja....
L: Då kommer det upp då..., mmm ja nån speciell uppgift i astronomi som nå'n har kommit på eller nytt demonstrationsexperiment i ellära å, å...
I: Mm!
L: ... får man visa det å..., så'na där saker dyker upp va, å så.... Pedagogiska vinklar då, så det är väl mest med vissa som man sitter å snackar, Jan Hedman å Lennart Häggström, Tore Eriksson, Mauritz Kaupi ja.., Johan Larsson, då vi som brukar sitta där å då blir det ju snack om pedagogik, visst är det så.
I: Ja. Men det behöver inte nödvändigtvis vara just lärarlag utan mer så'na man känner att man kan snacka så'nt med?!
L: Ja det är bara kollegor i gement som man träffar ofta.
I: Ja just det.

L: Det där med lärarlag det..., det finns ju inte organiserat egentligen va, det finns väl, av nöd och tvång då eller spontant kanske kan uppstå...
I: Vad menar du med lärarlag? Vi kanske menar olika saker!
L: Ja lärarlag i till exempel mekanik eller ellära, en större grupp som har hand om ett ämnesområde å utvecklar det hela å organiserar kurser. Okej ett lärarlag på 4 som har räkneövningar som lektioner i en kurs i kvantmekanik, det är ett sorts lärarlag det också.
I: Ja.
L: ...men då blir det det här, eh..., praktiska kortfattade det handlar om för det mesta va.
I: Mm, just det. Ja, dom här å dom här uppgifterna....
L: Eller om man upptäcker nå't dubiöst i boken eller nå'n uppgift eller nå't så'nt där då snackar man om det.
I: Ja... Ehm, om vi går tillbaka till enbart läraren igen. Vad är din bild utav en riktigt bra lärare? Kanske en lärare som inte ens finns, en så'n här riktig superlärare. Vad är det som karakteriserar en så'n skulle du vilja säga?
L: Ja han måste kunna en del för det första. Inte vansinnigt mycket på grundläggande nivå men betydligt mer än studenterna, det är punkt ett.
I: Ja.
L: Jag skulle nog vilja säga att en kurs i atomfysik så är det nog bra man sysslar med atomfysik och disputerat det hjälper oerhört då.
I: Absolut.
L: Eh, se'n måste man väl tycka att det inte är obehagligt.
I: Mm...
L: Det behöver inte nödvändigtvis vara skitroligt å så..., jag tycker nog att det är roligt ofta, framför allt när man får dom att upptäcka nå't nytt med en demonstration men alltid så är man inte tänd. När man har 5, när man har samma lektion för 5e gången för en grupp, civilare, då är man inte heltänd. Men, visst att gilla det hela då, någelunda. Sen måste man ju vara någorlunda vänlig, mungiporna någorlunda uppåt, det tycker jag.
I: Mm.
L: Inte vara sur och grinig, eller utan åtminstone..., ja det finns ju kolleger från förr i tiden som haft den stora oturen att verka väldigt buttra å sura fast dom kanske egentligen inte har vart det, det är bara deras sätt va...., väldigt hjälpsamma, väldigt strukturerade å bra, ja, men ändå fått dåliga värderingar för dom verkar buttra. Man får inte verka...
I: Tjurig...
L: Tjurig å sur va... man ska vara lite positiv. Ja..., sen tycker jag det

här med att strukturera det tycker jag är väldigt väsentligt, så att man kan hjälpa dom genom en stor textmassa.
I: Ja...
L: Så att man inte läser formel för formel å tror att det här är viktigt, det här psalmvers 1, psalmvers 2, utan man får en överblick, å då måste man ta bort väldigt mycket detaljer å få dom att inse att det finns, dom stora formlerna som man kan skriva på handflatan i stort sätt å utgå från dom, det är nå'n sorts struktur då som man ska ge. Ja...., vad mera..., det är vad jag kommer på i alla fall.
I: Mmmm...
L: Se'n är det bra förstås om man har en sorts ideologi då som är baserad eventuellt på vetenskap, pedagogisk forskning, men den är ju så jäkla osäker vad jag kan förstå. Ofta är det små populationer man tittar på, men om det funnits experiment, pedagogiska, som sa gör så här då blir det bra, gör inte så här då blir det dåligt med stor ..., ska vi säga..., ja signifikans då. Konfidensnivå, då kan man som lärare på undervisningen....
I: Anamma det liksom ja....
L: ...anamma det. Å..., då har vissa av oss anammat conceptual physics, rätt mycket. Å jag vet inte hur pass välgrundat det är, men vi tycker att det funkar så därför kör vi med det ändå, fast det inte är vetenskapligt helt grundat men..., vi har läst Cedrics rapport om dom här..., om minnet.
I: Mmm..., just det.
L: Då har man dom här två olika typerna av inlärning då, den traditionella å conceptual physics. Det är väl ett stöd.
I: Ja.....
L: Så att då..., det är väl också nånting att ha, en medveten metodik som förhoppningsvis är förankrad vetenskapligt.
I: Ja...., just det....
L: Inte bara nå'nting som man har hittat på själv.
I: Jaa....., tänkte på det när du prata om det här med strukturering å så där, det... mmm..., om jag försöker sammanfatta det du säger så känns det på nå't vis att du, eh, du vill hjälpa studenterna att strukturera upp och hitta det som är viktigt att lära sig att det kan på nå't vis ge, hjälpa dom att se sammanhang mellan olika saker. Är det det du är ute efter?
L: Ja, det kan man väl säga. Är man hemskt rak på sak så är det för dom att klara tentan också.
I: Ja visst..., absolut.
L: Visst, å det är dom mycket intresserade utav va..., å får dom veta det så är det bra.

I: Ja.., ja.
L: Eh, jag vet hur det var för, jag hade för 24 år sedan ett gäng studenter, bara iranier.
I: Jaha.
L: Dom behövde stödundervisning i mekanik.
I: Okej.
L: Å dom misslyckades kapitalt, på den vanliga tentan. Å sen då när jag hade dom enskilt då insåg jag att dom läste fysik precis på det här sättet, formel för formel för formel, ord för ord va.
I: Ett är lika med...
L: Mekanikkursen är alltså 1768 formler som dom skulle kunna lära sig utantill, å när man skulle använda sig av vilken formel hade dom ingen aning om.
I: Nej...
L: Nej dom klämde till med nå't.
I: Ja.....
L: Dom kunde aldrig inse att man kunde köra Newtons andra lag å se'n då tillämpa den då,... enligtett enkelt recept, det begrep dom inte. Så att i det fallet var det uppenbart att dom behövde struktur.
I: Ja....
L: Ett annat sätt att lära sig.
I: Ja..., mm. Vad tror du studenternas bild av en superlärare är? Vad vill dom ha liksom?
L: Jag tror att dom ska, dom vill att dom ska tycka att det är lätt att lära sig det dom håller på med.
I: Mm.
L: Å lätt att tillämpa det. Det kommer jag ihåg när jag gick själv här då, lärde mig fysik, då hade jag på en kurs Rejnhold Hallin, vi har forskat tillsammans i många år va. Å då plötsligt tyckte jag vad fasen vad lätt det här var, han hade ellära, lätt som en plätt, full pott på tentan, det här var ingenting. Men det var vanlig kurs i ellära, med dom vanliga ingredienserna, inte speciellt lätt eller svårt va, men han fick det då att framstå så vansinnigt lätt, det kommer jag ihåg alltså.
I: Ja...
L: Eh, nå'nting i den stilen att man eh, ja hjälper så att dom får lätt att lära sig.
I: Mm...
L: Se'n det här med att förstå också, det är ett krux, det försöker jag ha en liten föreläsning om, på dom flesta kurser jag har vad man menar med förstår och snarare inte förstår. Det hämmar ju väldigt mycket om man

inte förstår.
I: Ja.
L: Herr Fineman har ju också en definition på tre typer av oförståelse, dom tar jag upp och går igenom...
I: Ja...
L: Å när dom säger att dom inte förstår då ska dom tänka efter, vilken form av icke-förståelse är det.
I: Ja...
L: Är det helt enkelt den här mycket vanliga att jag inte är nöjd, att jag är otillfredsställd, då ska dom inte ta det så hårt utan då ska dom försöka acceptera det som vi försöker lära ut så länge. Efter ett tag då kanske dom är nöjda å då säger dom att dom förstår. Förstå betyder egentligen att förstå ordet tycker jag, att förstå språk va.
I: Symboliken eller....?
L: Ja... Fineman säger så här, språk, jag säger nå'nting på ett utländskt språk 'skrvitrtjrkrkr!' på tjeckiska å du förstår inte.
I: Nej! (skratt)
L: Det är alltså fundamental oförståelse, jag säger att det uträttade arbetet är negativ, det fattar inte en vanlig människa, men det fattar en fysiker....
I: Mm...
L: Eller så skriver jag upp Maxwells ekvationer, då fattar man att det är matematiken överhuvudtaget, men se'n kommer dom andra sakerna att man ser nå'nting som jag inte har sett förut. Cykelhjulet å snöret som runt va.
I: Mmm.
L: Det är ingen som förstår det, å det beror på att det är ingen som har sett det förut, det som man har sett förut 1000 gånger då förstår man ju att det är som det ska va.
I: Ja...
L: Det där är ju den här ordförståelsen som är meningslös, det gäller att få dom att komma över så'nt där att inte tycka att...., ja jag tycker inte om det här därför är jag missnöjd å sur å grinig.
I: Ja just det....
L: Utan kör på acceptera naturen som den är och så fortsätter vi 5 poäng å sen kanske vi blir nöjda, förstå du?
I: Precis, det kommer bit för bit....
L: Ja..., visst, visst.
I: ... faller på plats.
L: Man ska inte vara bekymrad när man inte förstår, nej... För att är

man elak, eh, eller lite cynisk så är det i grunden bara att acceptera för studenterna vad vi lär ut, det vill säga det vi har lärt oss, det är historia alltihopa..., egentligen.
I: Mm..., mm.
L: Så jag brukar säga att det här är en indoktrineringskurs, så är det ju.
I: Ja..ha...
L: Tänka fritt kommer inte på frågan, för då blir det fel.
I: Nej (skratt)...
L: Så är det ju! Ingenjören tänker fritt å räknar bron, då blir det fel.
I: Ja... (skratt) vi vill inte ha nå'nting så'nt. Okej, ehm, om vi går tillbaka till inlärningen hos studenterna i fysik, ehm, om vi pratar om din syn där i inlärning hos studenterna. Hur tror du att dina studenter lär sig fysik?
L: Ja....
I: Hur gör dom?
L: Det är väl olika..., moment..., i viss mån hoppas jag att dom lär sig via föreläsningarna att dom försöker följa den struktur, så nå't lär dom väl komma ihåg, så att det är inte meningslöst med föreläsningarna. Eh, se'n lär dom sig framför allt, när det handlar om mekanik då till exempel, att, eh, själv eller helst med nå'n kompis, å det gör dom, man ser dom diskutera problem och försöker lösa problem.
I: Mmm...
L: Då tvingas dom att tillämpa reglerna som man får samt lär sig, så att jobba tillsammans med andra å diskutera problem det tror jag är vansinnigt effektivt.
I: Ja..
L: Och se'n har du chansen att när dom har fastnat, trots allt vill ta upp nå't fråga mig på räkneövningarna å då har jag lyckats med dom att jag inte ska stå å lösa problem på tavlan, det är absolut inte, jag gör ingenting såvida inte nå'n ber mig om det.
I: Ja...
L: Då kan man göra dom på tavlan eller också om dom frågar om råd privat, det tror jag funkar alldeles utmärkt också. Men för civilingenjörer då ska det lösas problem på tavlan, för så vill dom ha det.
I: Ja..., tak, tak, tak, tak..., jaaa...
L: Ja dom, ja..., det kan hända att det är effektivt för dom, endel av dom också, jag vet inte, svårt att säga, vad som är bäst.
I: Men när dom diskuterar å så där då, till exempel två å två, studenterna, är det så att säga nödvändigt för dom att greja att meka med eller räcker det med att dom kommer på fråger själva å...., bollar...?

L: Vi kör, kör, vi är traditionella, vi kör problem ur en lärobok, vi har en apparat å ska räkna ut krafter å kraftmoment som verkar på olika ställen. Så att det är helt enkelt det.
I: Man kan rita å så....
L: Se'n på mekanikkursen får dom också ta ut olika mekaniska verktyg, domkrafter, tänger, korkapparater, ja sekatörer, vad som helst ta hem å räkna på dom här, dom får säga vad är bra med det här verktyget, vad är vitsen med det, räkna ut ett tal på vad man vinner, klippkraft, handkraft eller nå't så'ntdär.
I: Mm.., mm.
L: Men det är bara en enda uppgift, å där tror jag att det skulle vara bra alltså för ingenjörer, mera.... För det är svårt å hitta saker....
I: Mm... Jag ska byta s...
L: Ja!

BYTE AV SIDA PÅ BANDET!!

I: Så där, nu så är det igång igen.
L: Ja just det. Hur dom lär sig det var det vi var inne på?!
I: Ja det var det inne på.
L: Jo jag tycker förstås att laborationer ska va..., ge dom mycket, men så är det tyvärr inte ofta. Utan det är nå'nting som är obligatoriskt som man plöjer sig igenom.
I: Mhm...
L: I alla fall på civilingenjörsutbildningarna, då är tiden så vansinnigt kort å schemana så fulla, så att egentligen tycker jag att laborationen skulla ta mycket, mycket längre tid å man ska ha mycket mera frihet att hitta på saker å göra fel. Men det är svårt att införa, har man en kurs alldeles själv då kan man göra det...., som *** då har jag fördubblat laborationstiden, alltid något.
I: Har du huggit i någonting annat då eller.., har du bara...?
L: Ja det är så här att under årens lopp så har laborationerna minskat i timantal, hela tiden, det kan man se om man tittar på civilingenjörsutbildningarna 20 år tillbaka, det var mycket mera laborationer förr. Nu är det så vansinnigt många ämnen...
I: Jaa...
L: Det tillkommer ämnen hela tiden va, det är inte så konstigt, det är utveckling.
I: Nej..., det är utveckling...
L: Å dom ska in! Å då tar man bort nå't, å laborationer är en sak man tar bort förstås, så är det.

I: Är det för att det är kostsamt att ha laborationer eller...?
L: Njaaaa, det tror jag inte, mest tror jag för att man ska in med andra nya poäng, nya fräscha poäng. Till exempel ska man in med renrumsteknik på ***ingenjörsprogrammet å då måste nå'nting minskas, till exempel mekanik å nå'nting annat.

....

L: Dom tycker att dom lär sig. På dom här lektionerna, räkneövningarna är det väldigt olika, vissa gillar det väldigt mycket, tycker att dom lär sig, dom sitter där å jobbar tillsammans med någon annan eller ensam å så kan dom använda mig, andra tycker inte alls om det, kommer helt enkelt inte.
I: Nej...
L: Så att det är lite olika. Labbarna, ärligt talat vet jag inte. Men..., ingenjörer brukar i regel vara lite mera positiva kanske än vissa andra..., *** dom inser att det här är bra att hålla på med. Vibrationer å rotationsrörelser, det kan vara deras jobb alltså. Så att eh..., det ja..., dom tycker nog om det någorlunda men det är ändå så kort tid så att det ger inte så mycket. Det hinner inte sätta sig så mycket som det andra.
I: Nej....,eh......ja..... Hur vet du att dom har lärt sig nå'nting då?
L: Ja...., det är tentan, det, det, jag kan inte sva...., tenta på nå't sätt. Eh, på dom flesta kurser är det traditionella tentor, så är det. Å då poängsätter man och bedömer, å ser att vissa har en fantastisk förmåga att klara alla beräkningsuppgifter, andra klarar ingenting, eh..., det är väl den huvudsakliga bedömningen.
I: Mmm...
L: På ***-kursen finns det inga skriftliga tentor, utan då är det bara prestationer på laborationer, seminarier, allmän aktivitet, ska bedömas, å det tycker jag är vansinnigt svårt!
I: Hur gör du för att få en bedömning?
L: Det törs jag knappt säga! Det törs ingen annan säga heller hur vi gör! Vi försöker sätta VG å G va, U kommer inte på fråga för det är snarare ännu inte godkänd då. Alla som gör alla obligatoriska moment och är närvarande tillräckligt mycket blir godkända. Åh vad svårt! Jag försöker bedöma labbrapporter, projektrapporter, muntliga presentationer...
I: Dom skriver så'nt i alla fall?! Det är inte bara muntligt.
L: Ja, dom skriver en del projekt det gör dom...., ja visst. Det finns en del skriftlig rapportering, det gör det.
I: Ställer du liksom frågor å så där under tiden så att du liksom bildar dig, å, jag vet inte, hur många jobbar dom i grupp eller jobbar dom...?

L: Det är olika, det kan vara grupp om 2, 3 eller 4 eller enskilt eller nå't så'nt, det varierar. Så det blir en kollektiv bedömning också.
I: Ja, det måste bli det va....?
L: Vansinnigt svårt. Hur bedömer man gruppen? Den går inte att särskilja, va, i så fall, tycker jag. Sedan att skaffa sig en uppfattning att du är dum å du är smart det kan man inte bara skaffa sig utan ha nå'n saklig grund också å gå efter. Man kan inte bara titta på folk å tycka nå't, det räcker inte!
I: (skratt) Du, du har ring i örat....
L: Ja just det, jag gillar inte dig!
I: Jag gillar inte dig....
L: Naj, för mig är det tentor. Det är klart att när man pratar med folk så får man en uppfattning givetvis! Det är självklart.
I: Men det är bara en viss sorts uppfattning eller är det....?
L: Ja det är det ju, och på traditionella kurser så brukar ju den inte komma med i betyget utan där är det tentan rakt upp och ner va.
I: Nej, det är bara tentaresultatet....
L: Så är det.
I: Skulle det vara bra att komplettera varandra eller... eh...?
L: Både ja och nej, man kan inte säga så här att 'Det du säger under den här kursens gång till mig kommer jag bedöma.' Då bli dom stumma, det går inte. Då ska man ha nå't, eh, seminarium eller munta, muntligt test då. Och..., jag har muntliga prov ibland, men det är bara i restfall.
I: Kompletterings....
L: Ja för jag orkar inte med det annars. Å då går till så här att om man har ett gränsfall, om dom har klarat nästan 3 problem av 6 på tentan, då är man nästan godkänd, då får dom helt enkelt hemma, med vilken hjälp dom vill lösa de 3 problem som gick dåligt å så kommer dom tillbaka till mig å berättat hur dom har gjort å förklara i detalj, då har dom tvingats lära sig å så får man förmodligen veta om det är bara kompisens anteckningar eller om dom har antecknat.
I: Faktiskt förstått nå't själv.
L: Så där skulle man egentligen göra med alla va, oavsett om dom har 2, 3, 4 eller fem på tentan men det...., orkar man inte med tror jag, jag vet inte, känns inte så.
I: Nej..., men kan man liksom ställa fråger så dom..., att man ser på dom att dom inte kan svara eller för att dom blir så 'uuhhh' flummar runt å...?
L: Vid ett speciellt tentamenstillfälle så..., jo det klart man märker så'nt, det är klart. Men en muntlig tenta måste ju ta en så där halv timme ungefär, det är väl den rimliga tiden det kan ta. Å har man då 40 stu-

denter så är det 20 timmar som ska avsättas.
I: Mm.
L: Å jag har hittills varit för lat för att syssla med det, å dessutom har man annat att göra, så att det...
I: Ja, ja..., absolut.
L: Så ligger det väl till, det blir skriftlig tenta.
I: Ja, så har jag också. Det här kunskapsgapet som vi kom in på förut, att det måste finnas så att läraren kan mer än studenterna. Hur överbryggar man det? Alltså hur...?
L: Hur då från lärarens sida gentemot studenterna?
I: Precis!
L: Att man inte ligger på fel nivå, är det det du menar?
I: Jaa.., alltså hur kommuniserar man sin kunskap som ligger på en helt annan nivå än studenternas? Det var så jag tänkte.
L: Ja, jo. Det beror ju också på nivån förstås, vilken kurs man har. Eh, men..., om man kör concetual physics så är man ganska så elementär i början om man tittar på enkla fenomen å inför begrepp för att beskriva dessa enkla fenomen, elektriskt fält kanske man hittar på, magnetiskt fält, sen jobbar man vidare med det. Så att då blir ju början lite barnslig å enkel å se'n kan man ju bygga upp det i forsättningen på en högre nivå då. Men..., jag tycker inte det är nå't problem även om man kan saker lite bättre. Jag kör ju inte igång med tensoroperatorer i atomfysiken va, nå't så'nt på en gång utan då...
I: Nej....! (skratt)
L: Man..., berättar att man upptäckte nå'n konstig sak som hette elektroner, som man kallade för elektron på 1890-talet. Det blir ju historisk utveckling uppbyggnad då, bättre å bättre beskrivningar, successivt, man inför begrepp, så får det gå till va.
I: Mm. Men dom har en viss stomme som du känner till att dom har, då går du vidare, skulle man kunna säga eller...?
L: Vis, vis, eh, vetande, litegrann kan, eh, kanske gymnasiet, men nu är det så olika så man vet inte det heller. Men jag har ju mest, eh, fundamenta..., grundläggande kurser på A-, B-nivå. Jag har en doktorandkurs.
I: Mm, just det, laser...
L: Å då får man förstås starta på en annan nivå, då får man förutsätta att dom har elementär kvantmekanik, atomfysik, molekylfysik, fasta tillståndet också, då utgår man från det.
I: Mm.
L: Så är det.
I: Så är det. Ehmm, m, m, vi ska prata om en annan sak också, å det

kanske du har hört av Cedric. Scholarship, att en person är scholar eller är scholarly i sitt arbete.
L: Ja just det! Okej, ja.
I: Du är bekant med begreppet?
L: Ja, jag var på den första föreläsningen, mannen från Bremen vad han nu hette.
I: Jaaa, eh..., vad är det han..., Niedler..., Hans Niedler heter han ja.
L: Ja just det. Jo då pratade Cedric om det där å det minns jag inte perfekt men jag har...
I: Kan du beskriva för mig vad du kommer ihåg av det?
L: Nej...., jaha, ja vad ska jag säga, nå'n sorts yrkesroll, yrkes....kunskap, yrkesförmåga baserad på...., ja bästa fall vetenskap.
I: Jaha...
L: Ungefär så, det är vad jag kommer ihåg nu. Det kanske är helt fel.
I: Det är ett knepigt begrepp.
L: Va?
I: Det är ett knepigt begrepp.
L: Ja, ja.. bättre kan jag inte tror jag.
I: Nej.... eh, jag tycker att det låter som en ganska bra översättning till svenska. Jag har haft problem med det här ordet å försökt slå upp det i ehm...
L: För mig är det stipendium, men det...
I: Precis, det var det första som jag tänkte på också! Men om man slår upp det i en uppslagsbok så, så står det för lärd, vetenskap.
L: Det låter ju som lärarskap.
I: Ja lärarskap, precis. Ehm, så som du förstår ordet, skulle du se en koppling, kunna se en koppling till undervisningen, på nå't sätt?
L: Ja självklart, vad då, vad annars skulle, nu hänger jag inte med, vad då? Skulle man va, ha scholarship å aldrig syssla med undervisning, eller vad menar du?
I: Em, jag kan säga...
L: Det kan man väl ha, men då är man väl pensionär eller skiter i undervisningen, forskar i stället.
I: Ja..., jag kan man säga så här att det är många som överhuvudtaget inte ser den kopplingen, ehm....
L: Mmmhm! Menar, menar om nu någon personligen går in för att skaffa sig lärarskap eller den här egenskapen...
I: Lärdomhetsskap.
L: Lärdom, lärdomhetsskap! Å lärdomhetsskap!
I: Så skulle jag...

L: Lärdomhetsskap, okej.
I: Precis.
L: Ja, det kan väl skaffa sig på sin kammare å sitta å njuta av i..., här då borde väl användas, jag kan inte inse vad man annars skulle ha den.
I: Nej....
L: Så vida man inte är forskare i detta, lärdomskun...., då kan man ju skita i det, då kan man ju bara forska.
I: Då kan man ju bara forska...., fast det skulle vara ganska trist. På vilket sätt ser du den här rollen spela i den här lärdomhetsskapen då i undervisningen?
L: Ja...., det är så akademiska grejer. Jag tycker att en person som är medveten om detta, vad det nu är då och har denna egenskap borde ju ha bättre förutsättningar att undervisa än en annan kanske.
I: Mmm..., kanske ja...
L: Ja, jag vet inte. Jag är fortfarande osäker på vad som menas med begreppet så att.
I: Ja alltså, eh, det som menas med begreppet försöker man ju faktiskt fortfarande komma på...
L: Jaha!
I: Ja, så är det. Eh, men det som man säger idag då det är alltså att, det här med scholarship, den engelska termen då, innebär alltså vetenskapligt arbete, undervisning, till exempel 3e uppgiften och så vidare...
L: Mhm!
I: En lärdhet som ska användas i alla uppgifter som universitetet har, så kan man säga.
L: Ja all right.
I: Väldigt.....
L: Ja visst. Är man eh, lärd, eller en bra forskare så borde man i princip ha bättre förutsättningar att undervisa än om inte..., men det är inte säkert att det är så men...., det kan, tycker, man har ingenting kan ju försämras av dom andra faktorerna egentligen. Tycker jag.
I: Nej..., nej. Ja för jag tänkte på den hära idealläraren som vi pratade om tidigare så sa du att den åtminstone har kunskap i det den gör till exempel i....
L: Jadå, jodå hyfsade överkunskaper också så att man kan vrida å vända på saker å ting, angripa från olika håll.
I: Ja just det.
L: Det är väsenligt va.
I: Det är väsenligt.
L: Funkar inte det ena angrepps.., infallsvägen så måste man hitta en

annan.
I: Ja just det.
L: Tills studentrna säger 'Ja just det'. Så är det.
I: 3 förstår först å sen är det 3 stycken till å ...så, mmm. Okej..., bra..., är det nå'nting som du har kommit på under tiden som du vill tillägga eller förtydliga för mig?
L: Nej...., inget som jag kommer på nu, på rak arm nej.
I: Nej..., ibland är det så att man känner att hörr'ö du jag har inte fått prata klart. Okej, då tackar ja dig.
L: Okej.
I: Att du var med.