

Exploring the Scholarship of Teaching and Learning in University Physics in Terms of Crafting of Practice

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A paper presenter at the 11th Biennial Conference for junior researchers of EARLI
22-23 August 2005, University of Cyprus, Cyprus

Introduction

While the aim of university teaching should be to make learning possible, the aim of the Scholarship of Teaching is to make transparent how such learning has been, or is, made possible. From this standpoint, the exploration to be discussed draws on a larger study which has three central themes.

- First, how physics lecturers perceive that they have made learning possible in terms of how they craft their teaching practice in relation to how they have come to know their students as learners;
- second, the relationship between such crafting-of-practice and how lecturers reflectively see themselves and their teaching community working towards improving teaching and learning; and,
- third, the nature of any associated transparency that is generated.

In this presentation we focus on the first theme with the aim of contributing to a broadening of the understanding of the notion of the Scholarship of Teaching in university physics through an interplay between coming to know how best to create effective learning experiences -- “pedagogical content knowledge” (Shulman and Sykes, 1983) -- and the coming to know students as learners (c.f. Ramsden, 2003).

Scholarship of teaching

In “Scholarship Reconsidered” Boyer (1990) argued for a broader definition of scholarship than research alone. In so doing he generated four descriptions of scholarship that belong to a modern university: the scholarship of teaching, the scholarship of discovery, the scholarship of integration, and the scholarship of application. In this study we draw on the notion of the scholarship of teaching which has recently been subject to refinement arguments such as those done by (Paulsen and Feldman, 1995), (Glassick et al., 1997), (Bender and Gray, 1999), (Cambridge, 1999), (Shulman, 2000), (Trigwell et al., 2000), (Kreber, 2002), (Kreber, 2002), (Taylor Huber and Morreale, 2002), and (Trigwell and Shale, 2004). Within this development, a central common theme in the interpretation of scholarship of teaching is that a scholarly lecturer must have “genuine” knowledge in the discipline which he/she teaches. This genuine knowledge is built up around student learning and the associated pedagogical content knowledge with the aim of building bridges between lecturers' understanding and knowledge, and students' learning. This has recently been characterized as “pedagogic resonance” by Trigwell and Shale (2004). In this way we see the aim of university teaching being about making learning possible (for example, see Ramsden (2003)) and the aim of the scholarship of teaching to be about making transparent how learning has been, or is, made possible through the crafting of teaching practice.

Expansions of scholarship of teaching

Two of the most pertinent expansions of the Boyer's concept of the scholarship of teaching have been done by Glassick and colleagues and by Rice. Glassick et al. (1997) argue for the following activities being essential attributes of the scholarship of teaching:

- to be able to identify important and relevant questions in ones field, and anchor issues to surrounding areas;
- show an understanding for the field and have sufficient resources to move the research forward;
- use appropriate methods and modify methods effectively and accurately to achieve goals in the research project;
- have results stimulate understanding and learning in the field and be useful when new problems are being solved;
- communicate the results in a suitable style in appropriate forums and with an efficient organization; and,
- critically evaluate one's own work.

Rice (1992) expands on what he sees as the three distinct elements of the scholarship of teaching, viz:

“first the *synoptic capacity*, the ability to draw the strands of a field together in a way that provides both coherence and meaning, to place what is known in context and open the way for connection to be made between the knower and the known;
second, what Lee Shulman calls *pedagogical content knowledge* (Shulman and Sykes, 1983), the capacity to represent a subject in ways that transcend the split between intellectual substance and teaching process, usually having to do with the metaphors, analogies and experiments used;
and third, *what we know about learning*, scholarly inquiry into how students “make meaning” – to use William Perry (1970) phrase – out of what the lecturer says and does.”

Our view of scholarship of teaching

Shulman (1993) argues that a key element in the scholarship of teaching is the communication that takes place amongst colleagues. This is a view that Bender and Gray (1999) share. They claim that the concept of the scholarship of teaching points towards learning in the classroom being recognized as an activity. Both lecturers and students are portrayed as meeting each other in a series of ever-wider circles. We agree with these ideas of the scholarship of teaching but would like to emphasize the risk that this understanding portrays the scholarship of teaching as an individual and private matter as a lecturer, and does not invoke other persons into the development of knowledge of the discipline. We argue that the scholarship of teaching should be understood as a way of reflecting upon oneself and the community one is working in, in the process of making transparent the process and the outcomes of how learning has been made possible. From our perspective scholarship of teaching must be understood as multidimensional communication, not only directed from the scholar towards the rest of the community (such as students and colleagues etc). The communication in knowledge creation, as we see it, is most fruitful when all parties that are participating gain new insight, invoking new perspectives and knowledge about the discipline, about persons as learners. It is the interaction between the different parties that must be put into focus as well in the scholarship of teaching. In current research we believe the focus is too much on the lecturers. Without good interaction there will hardly be any creation of knowledge and the concept of teaching vanishes.

Methodology

Analytical framework

In order to investigate how physics lecturers experience crafting their practice against a background of how they see their students as learners we drew on a phenomenographic research approach (Marton and Booth, 1997) that aims at exploring what is called the “second order” (Marton, 1981, Marton, 1986) aspect of phenomenon. What is meant by *second order* is that the research is not aimed at exploring the phenomena itself, but *ways of how the phenomenon may be experienced*. The research focus is on the variation in experiencing phenomena, bringing out the qualitative variation of how a phenomenon is understood. This variation is not to be found between individuals but between different ways of experiencing, each of which cuts across different individual’s experiences – the variation is on a collective level. The qualitative variation discerned is embodied in categories of description, which stand in a logical and often hierarchical relationship to each other.

Method

Using the prevalent phenomenography data collection method we conducted 13 interviews with physics lecturers drawn from two Swedish universities. Here, questions dealt with issues of how the lecturers saw their practice vis-à-vis how they perceived their students as learners. The interviews were recorded and transcribed verbatim. Then the variation in meaning was described and made visible through an iterative, but non-algorithmic, process of grouping and re-grouping different pieces of data as part of the effort to capture their differences and similarities. The result being the formulation of categories of description that characterize the variation.

Results

From the transcripts of the 13 interviews a variation of understandings was captured from which we formulated five qualitatively different approaches to how lecturers view their practice, which constitutes the five categories. The central part of the analytic approach is to look for the relationships between the parts and the whole of the constitution of lecturers’ practice. These are then sorted to capture qualitative differences in the experience of the crafting of lecturers’ practice. These categories reflect qualitatively different focuses in perception of teaching practice – how lecturers perceive themselves as lecturers’ vis-à-vis the role played in making student learning possible in terms of coming to know students as learners. Issues such as goals and what motivated certain thinking and teaching initiatives played a fundamental role in the category formation. In terms of the breadth of focus relative to knowing students as learners (see Table 1) the categories can be seen to be hierarchical (A to E).

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 from such quotes to cover the fullness of a category. However, each quote is aimed at enriching the readers’ understanding of some of the characteristic features within a

category. It is also worth noting that it would be possible to categorize a lecturer in one or more categories, but such classification does not form part of this study.

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

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	Creating good images to represent knowledge for transmission
C: Intrinsic gratification	Pedagogical content knowledge	Personal development	Students as consumers	Gaining more knowledge about the discipline and students
D: Shaping of classroom environment	Pedagogical content knowledge from lecturers' perspective	Formulating a positive learning environment	Students as people	Formulating 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	Formulating a positive learning engagement

The categories described in more details

A: Practice founded on techniques for presenting

The focus of this category is the consideration on teaching techniques and on systemizing the discipline; it is the lecturers' 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, [...] setup 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 colour and nice fonts 'n everything and maybe even an animation 'n it looks good. But what was the value, eh, 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 shows 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 pays 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 the way to understand the phenomena. These two 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 are focused toward teacher transferring knowledge. The "technical rationalism" (Schön, 1983) that is expressed considers black-board-technique, using computer-simulations of a special phenomena, what equipment the student may use at laboratory classes etc.

B: Practice founded on presentation of the content

In this category the discipline content taught in a course is of greatest importance. Often the experiences depict 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. Our interpretation is that the argument implies that a good way for a lecturer to strengthen their 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, 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 the lecturer and students are not of great importance, instead the focus in this category is on making the content knowledge available to students, to describe physical situations as simply as possible. Another aspect which is well articulated is 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,

L: 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.

I: Mmm...

L: You show the way you should look at things. Erm, all, all students should know what the platform is.

L: Mmm, the social platform you mean?

I: 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 is characterized by descriptions in terms of self-development in both personal terms and in terms of knowledge of the discipline. In some sense there is 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 about the discipline and surrounding disciplines. This category is also characterized by the fact that the experiences presented are always pointing outwards from lecturers themselves, they being the central part of the situation. The descriptions originate from lecturers towards the students, very rarely the opposite way.

Another dimension of this category is the belief lecturers have about being accessible as a resource-bank for the students. They really want to appear as a "nice guy" who the students can ask any kind of questions. But still, they as lecturers are the central figure in the teaching situation.

One of the things is to help the students to teach themselves, that's what it'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 are 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 is on the students as a group; how they behave, what they ask, how they respond to questions from the lecturer, catching up 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 for a relationship is to have a dialog. 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. A couple of the 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 in this category are 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. But the interaction can be formed in two different ways which we will call themes.

One of the themes is 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 worldview. The activity should be among the students rather than by the lecturer, the lecturers' role is to give tasks or paradoxes with which the students can engage.

Another theme recognizes 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 contains a social-cultural way of viewing of the teaching.

Well, of course everybody thinks 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 individualised, then different aspects appear that you might not have thought about otherwise.

Discussion

We have outlined our reasons for investigating the variation of how these physics lecturers craft their practice in terms of how they know their students as learners in order to make learning possible. In summary we argued that such a study opens up new potential for broadening the understanding of the notion of the scholarship of teaching. The five categories described in this article delimit qualitatively distinct ways of viewing what practice is founded on in a physics teaching context. Each category is characterized by distinctive attributes, 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 foci in what one can develop, creation of meaningful teaching situations is still a very important aspect. The crafting focus in the lowest category in the hierarchy is towards one self, as a lecturer, and how ones' technical skills may be developed. Further up in the hierarchy, the aspects are focused towards 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 we had expected that a majority of the lecturers would show a spontaneous attitude that it is not necessary to have any development in their practice.

The second aspect is the lecturers' relationship with the students. In all the categories except the first, relationships to the students are pronounced. The range of relationships is huge but it exists. It was very interesting to hear how the lecturers approached students as a group of people, students as a group of total strangers which whom you are not sure you want to get too close to, 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 we think, in some sense reflects an ongoing reconsideration of relationship to 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.

The background descriptions, intentions and orientation of the teaching practice vary significantly between the categories. The most plausible reason for this variation, as we see it, must be dependent on the two aspects mentioned above: central development and relationship with students. And because these two aspects play a central part in the descriptions we would like to suggest that this is an important part of the concept scholarship of teaching. 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, 2002, Kreber, 2002), and (Taylor Huber and Morreale, 2002). These have focused on the activity a lecturer should take to be viewed as scholarly. In contrast, we have focused on the ways physics lecturers experience crafting their practice because, 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 an individual -- things very closely related. Thus we argue that the crafting of practice be seen as an integral part of the scholarship of teaching.

The intention we have with this research project is to contribute to the broadening of the concept of the scholarship of teaching by exploring the way that lecturers in physics are crafting their practice in terms of their students as learners and formulating pedagogical content knowledge. We feel, as Boyer suggested, that the scholarship of teaching is more than a set of "rules". It is a way of understanding the connection between the crafting of practice in terms of coming to know students as learners. This means that we would like to suggest adding "crafting of practice" to the "pedagogic resonance" of the scholarship of teaching.

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