Pedagogical Competence – a Model Promoting Conceptual Change in Higher Education

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Abstract—In this paper we discuss the importance of a learning perspective in relation to teaching and student learning in higher education. We conclude that conceptual change is crucial for the professional development of academic teachers, especially their understanding of the relation between teaching and student learning.

We present and analyse a model for pedagogical competence, involving four essential aspects of pedagogical competence – pedagogical practice or actual teaching activities related to student learning; observation of teaching and student learning; theory or theoretical knowledge of teaching and student learning; and planning as a means for improved pedagogical practice. We argue for teachers’ observations of teaching and student learning, together with reflected theoretical reasoning, to be especially important factors to promote conceptual change in university teaching.

Index Terms—Conceptual change, engineering education, learning perspective

I. INTRODUCTION

Evidence from research findings clearly indicate the superiority of a learning perspective in relation to student learning in higher education as opposed to a view where teaching is seen as transmission of knowledge from the teacher to the student [e.g. 1; 2; 3; 4; 5]. The Faculty of Engineering (LTH) at Lund University in Sweden decided as a priority to encourage a learning perspective in all teaching activities. In order to materialise in practice such a policy, teachers have to develop their ability to reflect on teaching and learning, and thus gradually adjust their teaching towards a student learning approach. It is not uncommon, especially within traditional engineering education, that teachers lecture with no or little reflection on how students learn the specific subject at hand. Therefore, the policy requires that many teachers have to undergo not only a conceptual change [6] in relation to how they understand teaching and student learning, but also that they develop their teaching practice accordingly. However, despite the ambitions described above, it is important to underline that LTH does not advocate or encourage any specific pedagogical theory or teaching method. What is emphasised is that student learning should be at the focal point of all teaching activities and that teachers should demonstrate a scholarly approach to their teaching practice [7; 8; 9].

Aligned with the tradition related to Thomas Kuhn’s ideas of ‘scientific revolutions’ [10], Posner et al. [6] suggested a theory of how existing conceptions can be changed or replaced in learning. Existing basic assumptions are challenged by anomalous observations forcing new concepts and new ways of perceiving the world to develop. Finally a conceptual change occurs.

The theory of Posner et al. [6] was primarily used to explain students’ scientific preconceptions or misconceptions and their resilience. However, conceptual change has also been shown crucial to professional development among academic teachers [4], especially their understanding of the relation between teaching and student learning, and potential implications for changes or modifications of existing teaching practices. Such practices can be hard to change. Teachers’ preconceptions of teaching and learning are often remarkably resilient and resistant to change. More recently, as shown by Åkerlind [11], academic teachers’ conceptions of teaching and student learning are also related to their overall conception of being academics. This means that a professional identity as a researcher influences the identity as a teacher, and vice versa; consequently, strategies to develop conceptions of teaching should be related to contextually existing academic identities. At LTH this means foremost the professional identity as a researcher.

Sinatra and Pintrich [12] introduced the concept of ‘intentional conceptual change’ and they pointed out that in a situation of conceptual change it is the learner (here the teacher) that is in control of a possible change. This has implications for the importance of affective and social aspects, such as motivation and beliefs, in addition to cognitive aspects. In this paper we will discuss the importance of teachers’ personal activities and involvement in pedagogical discussions for conceptual change.

Duit and Treagust [13] point out that there often may be a gap between teachers’ views and subjective theories and their actual teaching behaviour. They emphasize that it is necessary
to change teachers’ views as well as actions. Of course this is necessary if we want teachers to make the conceptual change from considering teaching as transmission of knowledge to facilitating learning.

In this paper we will show how a model, developed to illustrate the concept of pedagogical competence [14; 15], can be used as part of an integrated academic development program to promote conceptual change in teaching. Furthermore, the model, connected to relevant educational research, helps teachers to understand their teaching and its relation to the subject and their students’ learning. Conceptual change strategies thereby “may become part of teachers’ normal routines” [13].

The gap between teachers’ conceptions and teaching practice discussed by Duit and Treagust [13] is related to the theory of cognitive dissonance developed by Festinger [16]. Cognitive dissonance occurs when a person acquires new knowledge that is in conflict with his or her previous knowledge. The knowledge does not have to be cognitive but could also concern e.g. attitudes, behaviours or values. In the case of teaching and learning an important dissonance may be between a teacher’s knowledge about teaching and learning and the actual teaching practice and its outcomes. Festinger [16] argues that the tension between conflicting cognitions, the dissonance, is a driving force for change. People want to reduce or eliminate dissonance and achieve consonance. But there are several pitfalls. The dissonance could be reduced by simply ignoring new knowledge or by introducing new ‘creative’ explanations that decrease the tension without any real change [16]. Sometimes new knowledge does not generate dissonance and a new conception may be assimilated together with the existing knowledge. This is called ‘conceptual capture’ [17]. It could also happen that there is a strong resistance to reduce dissonance. Such patterns, Festinger argues, are quite common when the new knowledge relates to aspects of behaviour and thereby becomes overt in the social world. The individual needs confirmation by others in order to develop a new practice.

University teaching may very well fall into such a socially dependent category, as explored by Trowler and Cooper [18] in the format of existing teaching and learning regimes in departments or workgroups, or as even more subtle processes played out in significant networks [19].

In this paper we argue for the importance of a variety of arenas for scholarly discussions among teachers about teaching and learning in order to reduce resistance to change. We support the view put forward by Sinatra and Pintrich [12] that the learner (here the teacher) himself or herself should to a large extent govern the process leading to conceptual change. Consequently we argue for teachers’ own observations of teaching and learning activities to be the single most important factor to disclose dissonance and promote conceptual change. This should, however, include interaction within the entire professional identity, as it is constructed in the context of LTH, and within the social settings and networks available. The policy mentioned in the beginning of this introduction calls for a personal engagement by the teacher into the issue of teaching and learning rather than a usage of specific educational theories or practices.

II. PEDAGOGICAL COMPETENCE – A MODEL

Theoretical approaches within teaching and learning are often based on aspects of social sciences that are unfamiliar to most teachers in science and engineering. Conceptual change in engineering education is of course facilitated by a basic understanding of pedagogical theories, but also by the recognition of, and connections to, more recognizable scientific traditions within science and engineering. The use of illustrative models to explain and simplify complex pedagogical processes is an example of how a scientific tradition familiar to engineering teachers, could help them increase their understanding of teaching and student learning. It could also be used to facilitate processes described above, and thereby as a driver for pedagogical development.

One such model focusing on pedagogical competence has been developed at LTH [14; 15]. The model, illustrated in figure 1, involves four essential aspects of pedagogical competence – pedagogical practice or actual teaching activities related to student learning; observation of teaching and student learning; theory or theoretical knowledge of teaching and student learning; and planning as a means for improved pedagogical practice.

The pedagogical practice involves all kinds of teaching activities such as lecturing, experimental work, excursions, practices, supervision, assessment etc. It is within the pedagogical practice that student learning is actively supported through teaching. We identify the qualitative level of the pedagogical practice as teaching skills.

Observation of teaching and learning is invaluable if we want to increase the quality of the teaching practice. Such observations can be more or less systematic and structured. What a teacher observes and how observations are interpreted is closely related to personal teaching and an emergent learning perspective. Arguably observations and the
conclusions they influence are crucial in the process of conceptual change in academic teaching.

Theoretical and personalized knowledge about teaching and student learning is a fundamental part of a professional university teacher’s expertise. This knowledge can be achieved through formal training in university pedagogy, but informed pedagogical discussions are also important. The interplay between such knowledge and the existing professional identity as well as the social embedment of the individual teacher has been highlighted above. A theoretical area of particular significance is ‘pedagogical content knowledge’ [20], also, in the German tradition, called ‘subject didactics’. It concerns theories about teaching of a specific subject or subject area. Theoretical knowledge, together with observations of teaching and learning and a reflective attitude, is crucial for pedagogical development and conceptual change in teaching.

Planning for higher quality of the teaching practice and the implementation of new ideas constitutes the phase where a new understanding takes the form of a practice. This could be limited by framework factors, such as economy or programme design, but successful observations and theoretically underpinned reflections could also reveal new possibilities that would otherwise never even been considered. We name the ability to move through the complete circular model – practice, observation, theory and planning – pedagogical competence.

As graphically illustrated, pedagogical competence is a broader concept than teaching skills (figure 1), which is consistent with Magin [21] in his discussions of ‘demonstrated proficiency’ and ‘documented achievement’. Teaching skills, which is a central part of pedagogical competence, is demonstrated through a teaching practice that actively supports student learning. Subject matter content knowledge, pedagogical content knowledge, as well as curricular knowledge [20] are of critical importance. A professional teacher should continuously observe and reflect on the teaching practice and its effect on student learning. Based on theoretical knowledge and observations, the professional teacher analyses his or her teaching practice in relation to students’ learning and draw rational conclusions and make plans for continued development – the teacher thereby demonstrates pedagogical competence.

An excellent teacher must be able to reflect scholarly on his or her teaching practice in relation to theoretical knowledge of teaching and student learning. This means that reflection is an essential characteristic connected to all parts of the model presented above. A vast amount of research covering different aspects of reflection can be found in the literature. Three types of reflection can, on a general level, be associated with teachers’ reflection about teaching and learning. These are reflection-in-action, reflection-on-action [22], and reflection-for-action [23]. If we examine our model, reflection-in-action is likely to take place in the midst of a pedagogical practice, reflection-on-action is more associated with observations and theoretical knowledge, whereas reflection-for-action is closely related to planning of pedagogical practice. It is important to remember that the different kinds of reflections are interdependent and can be separated only analytically. The model (figure 1) with its four aspects guides teachers in becoming reflective practitioners and therefore serves as an important driver for pedagogical development.

Kreber and Cranton [24] suggest that reflection could be informed by two sources of knowledge: formal knowledge (or research) and personal teaching experience. In our case these bases for reflection correspond to the theory part and the practice part of the model. According to the model it is clearly advantageous if both sources of information are used and integrated when teachers reflect on teaching and learning. When teachers begin to utilize the model such a development is clearly stimulated.

Critical reflection and its importance in adult learning are central in the research presented by Mezirow [25]. He argues that content reflection, process reflection and premise reflection represent increasingly complex ways of reflection. Kreber and Castleden [26] discuss these types of reflection. They conclude that content reflection does not question whether our beliefs or conceptions are valid or not. In process reflection we question knowledge but only within the boundaries of our beliefs, whereas in premise reflection we truly question our knowledge and core beliefs. We argue that if we want to reflect beyond content reflection it is necessary to go outside the pedagogical practice (the teaching skills) and include observation, theory and planning. Process and premise reflection increase the possibilities for teachers to transform their conceptual structures to become more complex [25]. This in turn facilitates conceptual change in teaching.
The model of pedagogical competence (figure 1) is inspired by Kolb’s learning cycle [27; 28] and should be regarded as spiral-shaped so that pedagogical practice continuously achieves a higher and more developed level. Kolb’s model of experiential learning comprises four parts: ‘concrete experience’, ‘reflective observation’, ‘abstract conceptualization’, and ‘active experimentation’. Even though our model is related to Kolb’s model, there are important differences. The concrete experience in Kolb’s model is related to the teaching practice and both models include an observation stage. However, reflection is not just related exclusively to the observations but must be present at all stages, with somewhat different purposes, in terms of reflection in, on, and for action, as discussed above. The abstract conceptualization corresponds to the theoretical stage of our model, but theory here is more integrated and closely associated with all parts of the model. Finally, active experimentation could be seen as part of the pedagogical practice, and we have chosen to regard planning as a special stage in order to highlight its close relation also to observation and theoretical considerations. Honey and Mumford [29] discuss individual experiential learning styles for each stage of Kolb’s cycle. These are activist, reflector, theorist and pragmatist. We would argue against such a categorization since a successful teacher must master all of these styles interconnected at the same time.

We also build on Argyris and Schön [30; 31] and their concepts of theories-in-use and espoused theories together with single-loop learning and double-loop learning. These concepts are especially fruitful in connection with cognitive dissonance and conceptual change.

What people really believe, feel or think about reality is often revealed in their actual behaviour or the actions they take in different situations. Consequently, a teacher’s genuine views and feelings about teaching and student learning are seen in his or her teaching practice. Implicit theories (often tacit and personal) that people habitually base their actual behaviour on – theories that in fact govern actions – are called theories-in-use [30]. Theories (often common and renowned) that people declare or argue that their behaviour is based on – theories that are claimed to govern actions – are called espoused theories [30].

“For someone is asked how he would behave under certain circumstances, the answer he usually gives is his espoused theory of action for that situation. This is the theory of action to which he gives allegiance, and which, upon request, he communicates to others. However the theory that actually governs his actions is his theory-in-use, which may or may not be compatible with his espoused theory; furthermore, the individual may or may not be aware of incompatibility of the two theories.” [30, p. 6-7]

For developmental purposes it is important to expose inconsistencies between espoused theories and theories-in-use. Sometimes these inconsistencies resemble differences between policies and practice. Argyris [32] argues that effectiveness results from developing congruence between espoused theories and theories-in-use. This has significant consequences for teaching. Often theoretical knowledge of teaching and learning corresponds to espoused theories, and the teaching practice, the actual teaching activities, are more or less based on personal theories-in-use. If we want to promote conceptual change towards a learning perspective we have to find ways to establish and sustain connections between theory and practice. That is, improved teaching practice as well as conceptual change may emerge as teachers relate their espoused theories to their teaching practices. We therefore argue that high quality observations of teaching and student learning together with reflected theoretical reasoning (figure 1) have the potential to result in conceptual change as well as changes in teaching practice.

Furthermore, Argyris and Schön [30] introduced the concepts governing variables, actions and consequences. Actions will have impacts on the governing variables and result in consequences. When the consequences are not those that are intended, based on the particular actions, theories-in-use are not confirmed. This mismatch between intention and outcome could be solved in two ways. If only actions are changed, the process is called single-loop learning. But if the governing variables as well as actions are changed, the process is called double-loop learning. The most important feature in double-loop learning is the ability to draw conclusions from data, and also the encouragement to publicly test hypotheses and viewpoints. This is consistent with the use of observations as exposed in our model (figure 1). Teachers that only work within their own teaching practice, without observing teaching and student learning, and without reflecting with the use of pedagogical theory in combination with some kind of peer review, are likely to learn only through single-loop learning. Teachers that demonstrate pedagogical competence are much more likely to produce double-loop learning. We argue that observations of high quality are essential for the enhancement of double-loop learning and the potential for conceptual change in teaching.

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REFERENCES


