Applied Theory of Science in Higher Education Development

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Abstract

The paper shows how the Theory and Philosophy of Science may contribute to a discipline specific higher education development with focus on the academic teachers' concepts about knowledge, teaching and learning. It will be reasoned that a thorough reflection on essential scientific traits of any discipline has a purposeful impact on those concepts.

Introduction

For quite a while, Higher Education developers have been confronted with a certain challenge on a daily basis: how can we deal with (and within) multiple and diverse disciplines? Since the topic of discipline specific educational development seems to be constantly on the rise, the question emerges how professionals in general higher education centres can effectively react to this tendency. How can one person responsible for the development of teaching and learning in several disciplines facilitate an in-depth reflection on the specific needs and characteristics of those disciplines? How can diverse academic teachers and students finally benefit from it?

The first question may be: What makes up the expected differences between scientific disciplines? It seems to be possible to focus randomly on very different aspects of the topic at hand. For example, scientific cultures and sub-cultures, disciplinary discourse, organizational structure, financial models of faculties, demographic background of researchers, teachers, and students alike.[1] And, of course, disciplines differ from each other in regard to their topics, applied methods, and underlying theories. We shall call this last aspect the *content* of a discipline for now.

Someone could argue that higher education (HE) development should not try to get involved with the content level of various disciplines. Reasons are: HE developers are most likely not proficient in all those diverse academic fields of topics; they may get involved in discussions with their clientele which diverts them and lures them away from a general perspective on HE; hence they may even prevent researchers and teachers from an autonomous transfer of HE strategies on their specific discipline; involvement may finally result in entanglement.

We agree with this argument to a certain point. But we would also like to point out, that *content* does not only refer to the very details of a discipline's subject-matter. It also refers to methods, methodology, theory-building, and scientific assumptions. *Thus, our basic idea is a simple suggestion: the reflection on scientific theory and philosophy of science may improve the quality of teaching, learning, and HE development*.

One could reflect on three different levels: students, teachers, and HE developers. Since we would like to focus on educational development, we are ignoring the fact that scientific theory

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[1] See Becher (1987a, 1987b), and Huber (1990) for an in-depth analysis of cultural differences and social structure at university.

is also a major concern for every *researcher* in her daily work. Instead, we shall concentrate on the impact of a theory and philosophy of science on the quality of teaching and learning. The following three paragraphs will outline a specific development model that shows how HE developers may facilitate and benefit from reflecting on the theory of science when working with multiple disciplines and faculties.

Scientific attitude and the lifeworld

Every path into a new academic discipline starts from common knowledge and lifeworld experience (Schütz, 2003). This is true for students as well as for graduates or HE developers. There is no such thing as a 'displacement', which would take a young student and relocate him in a newly discovered science, formerly unknown and unthinkable (Meyer-Drawe, 1982, 35). Instead, every science evolves from lifeworld-experience and common knowledge.[2] A reflection on scientific assumptions and their resulting methodologies may follow a similar path. Thus, if we want to facilitate a reflection on scientific presuppositions, we could ask teachers, students, or ourselves to reflect on and describe the everyday practice and basic routines of scientific work within a discipline.

This may sound trivial; but it is necessary to stress the significance of this point: *If I want to understand how a discipline describes, experiences, and (figuratively or actually) controls the world, I have to observe the very basic practice of 'doing' the discipline in everyday life*. This is the starting point from which scientific research and teaching relate themselves to theory, spoken or unspoken assumptions, goals, needs and so forth. When I ask a scientist about what makes up her daily work, she has to relate it to her conceptual framework which finally makes up her discipline. We could also say: she has to relate her everyday practice with theoretical assumptions in order to create *meaning*.[3]

For that reason, Alfred Schütz spoke about *finite provinces of meaning* when he referred to the world of scientific theorizing and research (Schütz, 1962, pp. 245-259). Every discipline has a unique view on the world and uses very unique assumptions and resulting methods in order to distinguish, discuss, and explain its subject-matter. Because they are so unique and reclusive, disciplines may be called *provinces of meaning*. And those provinces are characterized by a set of rules which must be obeyed. These rules define what is valid or invalid, true or false, acceptable or inacceptable within a specific scientific discipline (Schütz, 1962, p. 251). This, in turn, is the basic concern of a theory and philosophy of science.

If I want to reflect on what constitutes the elemental core of a discipline, I have to learn those rules and relate them to lifeworld-experience. *Therefore, every reflection on scientific assumptions, methodological differences, or definitions of a specific discipline should start with how everyday work in this discipline takes place and attains meaning*.[4]

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[2] For the lifeworld as a universal common ground of all science cf. Husserl (1976), §§ 33, 34.

[3] Schütz's concept of social meaning is developed in Schütz (1932). For our purpose, the relation between everyday life and science as two distinct provinces of meaning is more relevant. General thoughts on finite provinces of meaning can be found in Schütz (2003), pp. 54-68.

[4] The importance of the lifeworld as a 'paramaount reality' (Alfred Schütz) cannot be fully adressed here. It is developed by Edmund Husserl and Alfred Schütz in their above cited works (among others). Anyway, it shall be mentioned that one reason for its importancy is the fact that communication and application of sciences almost always take place in the commonly shared lifeworld. There, thoughts become visible and meaning becomes communicable.

A development model for an applied theory of science

So far it has been said that a reflection on scientific assumptions, rules, and methodologies benefit from a lifeworld perspective. But for what reason and to what end?

From a sociological and phenomenological perspective we implemented reflections on basic principles of a theory of science into our seminar concepts. Thus, the theory and philosophy of science provides a framework of understanding for academic teachers and students alike. This framework aims at the teacher's competence to reflect on his own fundamental scientific aspects within his discipline and to implement those aspects in his own teaching. The expected result is to improve the comprehension of unspoken premises, boundaries, and limitations of the teacher's own discipline.

By spefically adressing the fundamental commonalities and differences between the own and related (or remote) disciplines, students are given the possibility to grasp the greater concepts behind their course of study. Regular reference to the disciplinary framework in the classroom situation not only supports the understanding of the subject-matter, it also encourages awareness for differences and an interdisciplinary discourse. So far, this is our basic assumption. We shall outline this assumption in five steps, which make up a development model. It may serve as a blueprint for HE workshops, consulting, or coachings, though it needs an appropriate transfer on a specific situation in any HE development process.

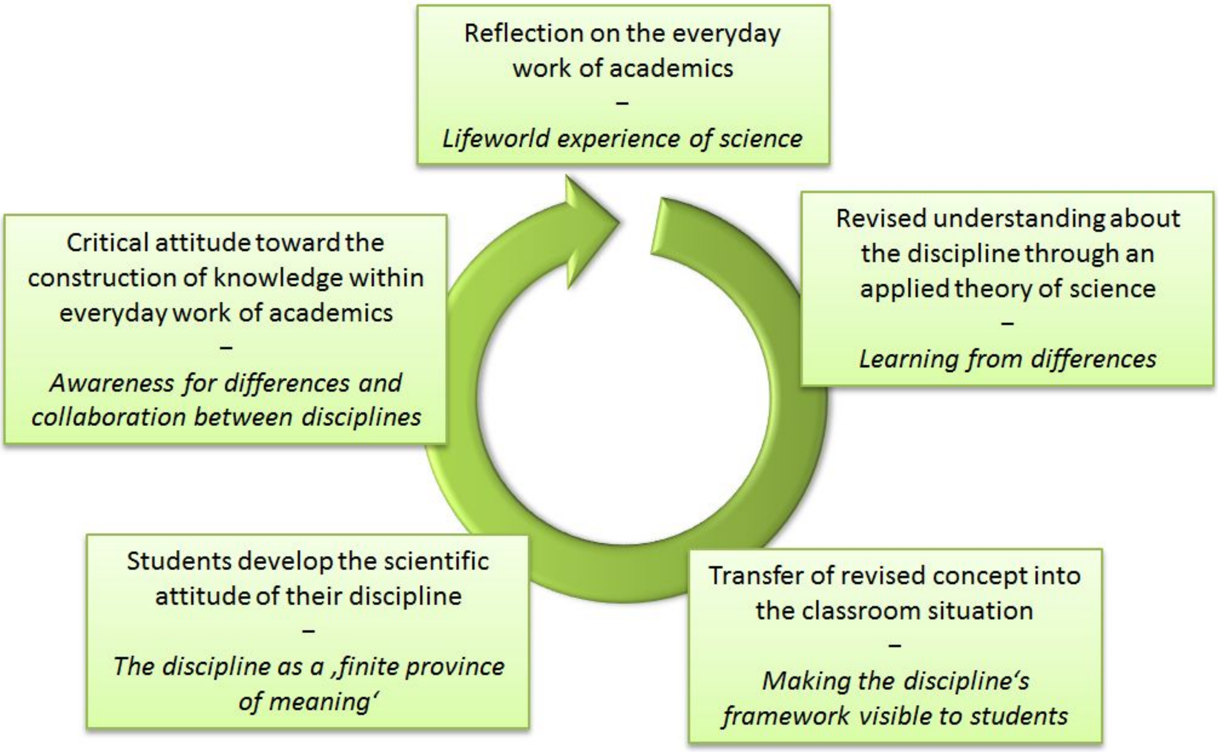

Figure 1: Development Model

(1) We assume that every personal development of scientific background knowledge, theory of science, and methodology should start from the lifeworld experience and the experiences in everyday work. Since this point has already been stressed in the preceding section, we will keep it short at this point. The actual actions of scientists in their daily routine should be questioned, compared and related to scientific assumptions, rules, and conceptual frameworks of their disciplines as well as between different disciplines.

(2) If university teachers or researchers are encouraged to reflect on the lifeworld fundamentals, basic assumptions of their discipline, and aspects of a theory of science, *this should lead to a revised understanding of knowledge and concepts about their discipline* (Meyer-Drawe, 1982). A reflection of this kind creates the scope for a greater framework in which the own discipline is related to other disciplines. Within this framework, new questions emerge: What makes my discipline unique? What are my disciplinary boundaries? What are my implicit assumptions and premises? What are the limitations of my theories and methods? Learning takes place, by comparing one's own discipline to other disciplines, and by asking fundamental questions within the framework of a theory of science.

This learning is characterized by criticism and relativization and it affects the concept of knowledge in general, not only the disciplinary aspects. The teacher's or researcher's systems of reference are changed. For that reason, *this learning process shall be called learning from differences*. It leads to a more complex understanding of the specifics of one's own discipline.

(3) This revised understanding of the own discipline and of the concept of knowledge in general also leads to a revised concept about teaching. Entwistle, Skinner, Entwistle, & Orr (2000) have shown that a teacher's concept about knowledge is related to his concept about teaching. This is the crucial point where HE development has the potential to create an impact on the actual learning environment. But in order to see this happen, *we have to make sure that there is a transition from the revised teacher's concept about knowledge and teaching to an actual revised classroom action*. In other words, if we encourage university teachers to reflect on scientific principles and the theory of knowledge, we also have to provide methods and instruments with which this new concept can be implemented in the classroom situation. We will discuss this point in the next section.

So far, the development model explains how a reflection on the scientist's lifeworld and scientific fundamentals may lead to a revised concept about knowledge and one's own discipline. Provided that there are proper instruments, this revision may finally reach the students as well. How would they benefit?

(4) The students are in a special situation. They are apprentices and confronted with the challenge to develop an understanding of the very essence of their discipline; not only facts and procedures, but an idea of what characterizes the discipline in contrast to other sciences and the everyday world. With the words of A. Schütz: *Students have to take on the special attitude, which corresponds with the province of meaning that makes up the discipline* (Schütz, 1962, pp. 250). They have to learn the rules of the discipline and its peculiarity. This is a learning process which takes a much longer time to evolve than the learning of a set of theories and methods. It involves the revision and rearrangement ("Umlernen"; Meyer-Drawe, 1982, pp. 34-41) of existing knowledge and the individual's system of reference. This transformation may take several years before a student may be called an 'initiate' of the discipline. University teacher may foster and support this process by making clear references to the framework of understanding, in which the discpline in question is located. This may include references to unspoken premises, to fundamental aspects of epistemology and methodology, but also to aspects of disciplinary culture, social responsibilities, challenges and so forth. *The vital point is that teachers reflect on the boundaries, premises, and limitations of their discipline, and subsequently support their students in developing a framework of references which puts their own discipline in relation to other disciplines as well as to the lifeworld*.

(5) As a conclusion, the development model stresses that university teachers of a specific discipline benefit from a genuine reflection on what makes their discipline special. *It is a question of awareness for differences as well as the ability to take on a critical attitude*

toward the own scientific work. Hopefully, this includes respect and understanding for different scientific approaches and, finally, leads to an increased competence for the participation in an interdisciplinary discourse. The students may benefit, if teachers are enabled to include such disciplinary reflections in the classroom situation. This constitutes the last step of the development model: How can such a process of reflection and revision be enabled and facilitated? Due to the significance of this final step it will be discussed separately in the following section.

Implementation in HE development

How can such a reflection on theory of science in HE development practically be implemented? First of all, it has to be kept in mind that there are three different levels of implementation:

- *University teacher level*: How is it possible to implement a reflection on theory of sciences and all its corresponding topics in a HE training scenario?
- *Student level*: How is it possible for teachers to implement references to scientific fundamentals and a theory of science in the classroom situation?
- *HE developer level*: How is it possible for members of the HE community to enable themselves to facilitate such processes?

Implementation on university teacher level

Imagine a usual workshop situation: several people from diverse disciplines are working together on challenges of their teaching and learning at the university. Differences are made clear, same problems may result in different perspectives and applied methods, different teachers tend to rely on disciplinary stereotypes, recipes and values etc. This situation of a cooperative learning environment is very fruitful for a reflection on scientific fundamentals and disciplinary differences. Three basic ideas on how to facilitate this in a workshop environment are presented below.

First, group exercises excel with their potential to confront different perspectives, ideas, attitudes and values in a very tight and intense atmosphere (Wellhöfer, 2012, pp. 65-83). HE developers may ask workshop participants to find a common description or solution to a given problem; participants may be asked to compare definitions of crucial scientific terms or basic methods; they could compare criteria for validity and so on. In short: *group exercises are one way to make academics experience fundamental differences between disciplines*. The set of possible exercises is identical with the set of scientific actions at all. Likewise, group exercises may reflect on the lifeworld aspect of disciplines, thus comparing usual actions in everyday work of the scientists and how they create meaning within a given science.

Second, a reflection could be facilitated by confronting teachers or researchers with elaborated concepts and historical facts about theory and philosophy of science. The history of philosophy is rich with fundamental problems and questions, which are still valid and important for most sciences nowadays. If they're not, the question is why? The Logbook Method[5] may be suggested as a helpful instrument to encourage and document such reflection within a workshop situation. A Logbook includes all relevant topics and questions which may be adressed during the workshop. Participants are regularly asked to write down their notes on

[5] A brief method description: All participants receive a logbook which they are asked to fill while the workshop continues. The logbook is a small notebook with plenty of free space. Every page offers a certain exercise or question, which corresponds with the topics and structure of the ongoing workshop. The logbook helps the participants to prepare, intensify, document, or adapt the workshop topics. It intensifies reflection. (Brauneck, Zimmermann, and Urbanek, 2000; translation by Th. Braun)

the present topic, to answer questions, to document results from group or individual exercises. When the workshop trainer is introducing aspects from the theory or philosophy of science, the participants are asked to reflect on this information from their own perspective and to develop statements and consequences on their own. *Finally, the participants should position themselves within the broad field of different, often antagonistic, sciences and scientific approaches*. The paper presentation at the ICED conference 2014 will focus on this Logbook method.

Third, there already is a given pathway that leads unerringly from every discipline into the philosophy and theory of science: the history of the scientific disciplines themselves. Every science has a narrative, which is usually an extraordinary story of invention, critical thinking, revolution and innovation. It is an inseparable part of a common history which defines the historical meaning of all sciences. *Therefore, starting with a reflection on the historical roots of a discipline can introduce to the problems of a theory of science*. The names of famous researchers, philosophers, or historical characters will finally evolve from this reflection. Their names are forever linked to certain ways of thinking and scientific attitude, to scientific debates, as well as social conflicts and social change. At this point, scientists from different disciplines may come together and search for common historical roots or differing branches. This is also the point where it leads to a more intense reflection in terms of a theory of science.

Those three examples give an impression of how to facilitate a reflection on the theory of science in a workshop situation. Other contexts of application are thinkable, namely coachings or consultations. It is up to the reader to adapt the ideas from this paper to her or his specific needs.

Implementation on student level

If HE developers want to make sure that an applied theory of science not only affects the attitude of teachers and researchers, but also the attitude of students, they have to make sure that teachers are able to transfer their changed concepts about their discipline into the classroom situation. While this is not necessary in a technical sense, it is highly desirable. Again, some ideas shall be introduced on that topic.

First, teachers should be encouraged to include explicit references to limitations, boundaries and epistemological fundamentals of their discipline into their teaching. When new topics are presented to the students, teachers may regularly indicate their position in the reference framework of the discipline as a whole. Why is this new content important? Why is it in accordance with the rules of the discipline? How does it relate to other topics or other disciplines? Those explanations may help students to locate new knowledge within their own reference system.[6]

Second, teachers should be encouraged to try to make the whole process of scientific work in their specific discipline visible to the student. This may include manifold aspects, like problem definition, selection of methods and theories, time schedule and everyday work, definition of daily goals and milestone, as well as results and consequences which may lead to publications, discourse within the scientific community, or social/technical change. The basic idea is, to approximate the research process with the learning process (Huber; van Wickevoort Crommelin, 2013). For example, while technical drawing with CAD is an important part of engineering, it may be introduced to the students not only as an allegedly singled out topic, but as an important aspect within a typical process of engineering research and problem solving.

[6] A similar approach and further references are offered by Schaper (20XX), p. 6.

Third, teachers should be encouraged to implement a circumstanced learning environment ("situiertes Lernen"; cf. Mandl, Gruber, & Renkl, 1993b; Mandl, Gruber, & Renkl, 1993a; Mandl & Krause, 2001; Wild & Wild, 20XX), which allows relating the learning situation to the lifeworld experience and common knowledge of the students. This means that teaching should make use of specific, realistic examples. Also, it is important to present new knowledge in its potential complexity, including critical assumptions, problems or practical trade-offs in the research process. *The bottom-line here is to flesh out the manifold relations and implications which accompany newly presented knowledge and to make sure that students have an opportunity to relate this new knowledge into the lifeworld beyond the actual classroom environment*. This is a crucial aspect for the development of the relational system of the consciousness, both in its active and passive dimension (judgement and reception).[7]

It can be said that all three suggestions follow the general appeal from John Hattie (Hattie, 2008, pp. 22-39), that teaching should be aware of making important hidden things visible to the students. Knowledge cannot be isolated and cut into pieces. It can be presented in a step by step process of teaching and learning, but then it must be visible why those bits and pieces are relevant to the discipline, subject-matter, neighboring topics, and the everyday work of scientists. Furthermore, the idea of visibility may also cover scientific assumptions, premises, unclear reasons, stereotypes, social implications, lifeworld relation, and even the history of a discipline. This, maybe, is the most important aspect of an applied theory of science in the field of university teaching and learning. It reveals the emergence and meaning of knowledge and promotes critical thinking and relativization in a discipline.

Implementation on HE developer level

HE developers may ask how they can possibly prepare themselves for such an application of a theory and science like it was outlined so far. *The most important prerequisite seems to be an attitude of openness for different motives, views, and actions within different disciplines. I would like to call it an attitude of open curiosity; asking why things matter and how meaning and validity is created in science*. Even without any knowledge about theory or philosophy of science, such an attitude may initiate a dialog between HE developers and scientists as well as among scientist of different disciplines.

However, asking the right questions becomes much easier if someone knows a little bit about the history of science in general, or about the history of some specific disciplines. *Thus, delving into the history of science seems to be a good way for HE developers to prepare themselves for their everyday work within a complex set of different disciplines*. It may be abstract and quiet a distance away from the practical concerns many teachers or researchers are confronted with in their daily work. But if HE developers want to facilitate a reflection on what makes a discipline special, it may provide an important basis to knowing something about historical roots and branches.

A next step may be that HE developers confront themselves directly with the basic questions and problems of a theory of science. *There exist both historical and systematical terms, which have a nearly monolithic relevance in respect to fundamental scientific assumptions and methods* (e.g. experience, ratio, validity, observation, hypothesis, conclusion). Those terms may be translated into specific questions, group exercises, or tasks in order to facilitate the reflection on scientific fundamentals. The number of published introductions into the theory

[7] This complex topic reaches out to very fundamental aspects of the consciousness. How does experience relate itself to pre-existing knowledge, pre-existing experience, and sensory data within the consciousness? Husserls work on active and passice synthesis demonstrates the importance of association, contrast, and homogeneity of perception for such acts as recognition, identification, and recollection of similarity (Husserl, 1966). The fascinating implications cannot be detailed here, though.

and philosophy of science is large, differing in perspectives and scopes. From there, someone can follow the path into the topic for as deeply as she wishes.

Finally, it is all about encouraging dialogue and collaboration between disciplines. Whether or not such an applied theory of science will have a productive and efficient effect on teachers' performance depends on several aspects, of course. For that reason, the last step of our development model requires the HE developers to carefully keep track of needs, prerequisites, and expectations in his or her environment. An evaluation should relentlessly address the critical questions: What do teachers need in order to help students find their way into the discipline? Is there really the need and interest for a reflection on fundamental scientific concepts? Does interdisciplinary collaboration really have any importance? What does the teachers and researchers finally take out of it, in terms of a lasting development process? Does the idea of an applied theory of science fit into the local HE development agenda at all?

Practical implications and prospects

It shall be made clear again, what the initial question was: how can HE development take into account the differences between disciplines – in the sense of subject-matter and methodology? The intention was to show, that HE developers do not have to be experts in every field, they just have to be experts in facilitating a reflection on disciplinary characteristics within teachers and researchers. This intention was justified by two major purposes: the possible improvement of learning quality and therefor the positive effects for the students on one side; the improved awareness of disciplinary differences on the other side. The latter includes prerequisites for interdisciplinary collaboration in research and teaching, which leads us to the insight that talking about discipline specifics also means to talk about requirements for interdisciplinary collaboration.[8] Above all, interdisciplinary work requires awareness for differences, mutual respect, and understanding of what makes a discipline's attitude unique. All three aspects are fostered by a reflection outlined in this paper.

From a broader perspective, *the reflection an applied theory of science offers, promotes the idea that teaching a discipline and its subject-matter should take place within a transparent framework with neighboring disciplines*. Borders and differences between scientific approaches should be made clear and presented to the students and teachers alike. That is to say that discipline specific knowledge appears in relation to other disciplines and should be treated with an interdisciplinary attitude. The suggested approach in this paper focused on this point. If researchers and teachers are experts in their discipline, it is the task of HE developers to make them think beyond. Taking into account the specifics, assumptions, and limitations of a discipline facilitates this thinking, which can be called *learning from differences*. The application of a theory of science in HE develompment then turns out to be basically a measure of making differences visible to teachers and students. It is this tracing of disciplines within an interdisciplinary framework of scientific thinking, which ultimately leads to the idea of a common universe of all sciences.

[8] For what those requirements are cf. Defila (2006). That interdisciplinary discourse – and successful comunication between sciences and the lifeworld in general – is possible at all, claims Alfred Schütz in an optimistic appeal (Schütz (1962), p. 257). In the western tradition, validity and the force of the better argument are inevitable principles of sound and respected scientific work. From that perspective, interdisciplinary discourse and its prerequisites may be described and analyzed with the terms and approach of the Theory of Communicative Action (Jürgen Habermas).

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