E-DIDACT - ENGINEERING PEDAGOGY AT UNIVERSITIES IN SAXONY - A RESEARCH AND FURTHER EDUCATION PROJECT OF TU DRESDEN AND UNIVERSITY OF APPLIED SCIENCES ZITTAU/GÖRLITZ

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This article outlines an approach to a common project of the Technical University Dresden and the University of Applied Sciences Zittau/Görlitz for the development, implementation and testing of a postgraduate distance learning further education course with integrated e-learning components aiming at the development of competences in the field of arranging teaching and learning processes in academic university education. The goals of this engineering-pedagogical qualification are derived from an empirical demand analysis. The modular structure of the postgraduate distance learning course is based on the structure of the studies of the International Society of Engineering Pedagogy to become a so-called Euro-Engineer-Pedagogue. The project has started on 1 September 2010.

Keywords: *Engineering Didactics, Higher Education, Engineering Education*

UNDERSTANDING OF "Engineering Pedagogy"

Engineering pedagogy has a very long tradition at Dresden University of Technology. The discussion on technical education and technical teacher training at TU Dresden (at that time Royal Technical Educational Establishment in Dresden) can be retraced to 1851. With the establishment of the Institute for Engineering Pedagogy by HANS LOHMANN in November 1951, teaching and research in the field of engineering education could be institutionalized. LOHMANN focused his research on the relationship of technology and technical teaching. Therewith he laid the foundations for an understanding of engineering pedagogy the matter of which is the targeted design of technical and technologically-specific teaching and learning.

A concept of engineering pedagogy developed in the 90s has not to be separated but to be distinguished from the latter understanding.

For students in engineering science courses a future engineers` ability to accomplish social communicative processes in modern structures of production and service moves into the focal point of engineering pedagogical considerations.
In Greek language, the etymological meaning of the term "pedagogy" includes the word "agein", which is to translate by the English word "lead" in addition to the word

"pais" (boy). Thus, the focus of this view of engineering pedagogy is the development of teaching concepts for preparation of future engineers for their leadership roles in changing structures of production and service. The following article is aimed primarily at an understanding of engineering pedagogy in the context of pedagogy of higher education.

CONCEPT OF A DEMAND-ORIENTED ENGINEERING PEDAGOGY

For teaching and research in the field of engineering pedagogy, an object-related reasoning shows the scientific level. Verifiable pedagogical and/or psychological qualifications are legally fixed requirements for a teaching career at all levels and in all types of schools of general and vocational education in Germany. In contrast, in the sector of higher education it is assumed that lecturers have teaching abilities due to their high academic qualifications.

The evaluation results of the teaching quality in higher education significantly show that this assumption is only partially correct [cp. Krempkow, R.; König, K.; Ellwardt, L., 2006]. A major reason for that is the complexity of the influence factors and relationships concerning the design of a demand-oriented education in engineering sciences. In this context, the term "design" includes planning, implementation and evaluation of teaching and learning in engineering education.

The requirement to gear engineering education to the demands of the economy, which is determined by the specifics of the engineering labour, is meant when speaking about demand-oriented and employment-based engineering education respectively.
Requirements are understood as necessary personal dispositions for successfully managing the profession-specific work activities. They are thus determined by the prevailing structures of production and service. The change from TAYLORistic production structures to structures of lean production in the past 40 years has considerably changed the engineering activities, and with them the requirements on engineers. A reference in this context is a study by FRIELING [cp. Frieling 1993], who investigated these changes in the German automotive industry in the 90s in detail, and who characterized the new production structures as follows:

- Process-chain-oriented company organization instead of functional hierarchies
- Customer-orientation instead of product-orientation
- Responsibility for the project/venture and budget instead of hierarchically structured task management
- Working in teams or groups instead of working alone

- Complete operations instead of individual/single acts
- Self-regulation instead of standardized input/guidelines
- Involvement instead of heteronomy
- Continuous improvement instead of hope for innovation.
  (cp. Frieling 1993, p.32)

Modern engineering education has to consider these developments in its curricula and training methods.

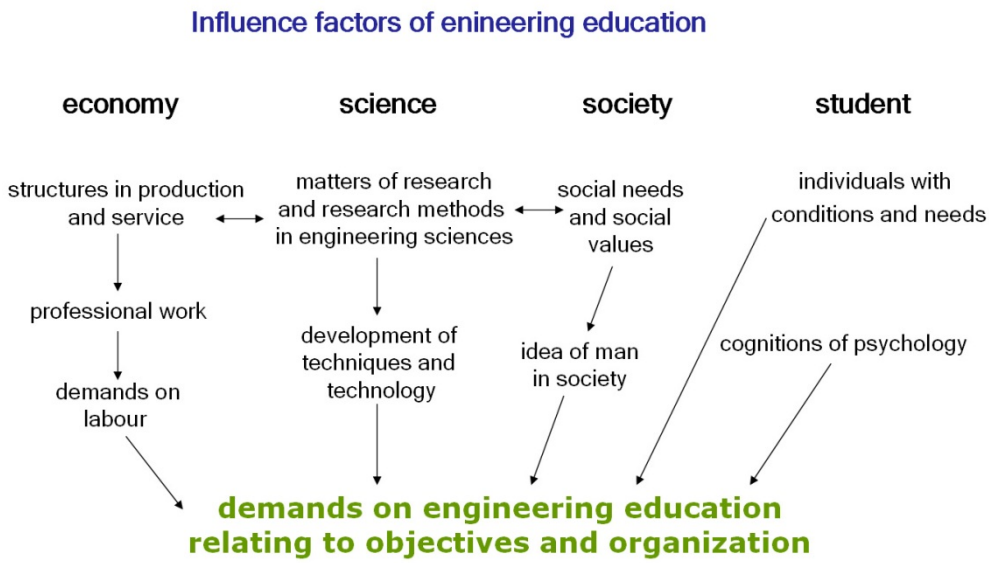


Figure 1: Factors influencing on demand-oriented design of engineering education

In addition to these dynamic requirements, a variety of stable long-term requirements related to the personality dispositions of engineers result from the typical engineering activities. An example is the typical way of the thinking/reasoning of engineers. For instance, in the analysis or the design of technical systems the thinking in the categories of **"**part – whole" in the relationship between structure and function plays a vital role. The calculation of technical systems by deductive structures of thinking is based on trusted statements or laws. However, in technologically diagnostic processes progressive-reductive patterns of thought in cause-effect relationships play an essential role. Such considerations lead to scientifically-based decisions for teaching methods in engineering education in order to support the development of such structures of thinking.

A second major factor influencing the training of engineers is the field of engineering sciences itself. A scientific discipline is defined by their particular

matters and methods of research. Regarding the matters of engineering sciences, the terms technique and technology play a key role. Technique and technology contain processes of change (form and structure), transport and storage of material, energy and information [cp. Wolffgramm 1994]. The views on what technique is and which function it has in relation to nature and society, is also subject to changes. A change of the matter of a scientific discipline has an impact on teaching in this discipline. The systems of statements in engineering sciences (descriptive matters), the systems of typical action rules for engineering activities (regulatory matters) and the systems of typical standards for engineering activities (normative matters) are different from those 60 years ago. Without adaption, LOHMANN`s approach to teaching technology is likely to hardly meet the requirements of modern engineering education. However, it can be considered a suitable starting point for the development of modern concepts of engineering education.

Closely related to the term "technique", is the society as a factor influencing engineering education. Technique not only arises from the application of natural laws and theories in engineering sciences but is also part of the technical possibilities and the socially desirable aims [cp. Heidegger/Rauner 1989, p. 20]. In this respect, the development of technique and technology is also driven by social needs. In addition, a society also has an idealized image of its members. Maturity ability to democracy, the willingness to active shaping are just a few personality traits that are included in this ideal. From this follows also an educational mission of our universities.

The fourth important factor influencing the engineering education is the low rate of success students have at German universities which is often explained by deteriorating levels of education in preceding educational institutions and the resultant lack of ability to study. I do not agree with such a general statement. But even if this thesis were true, it is economically not justifiable to let half of all young people who are interested in engineering fail in their educational intentions.

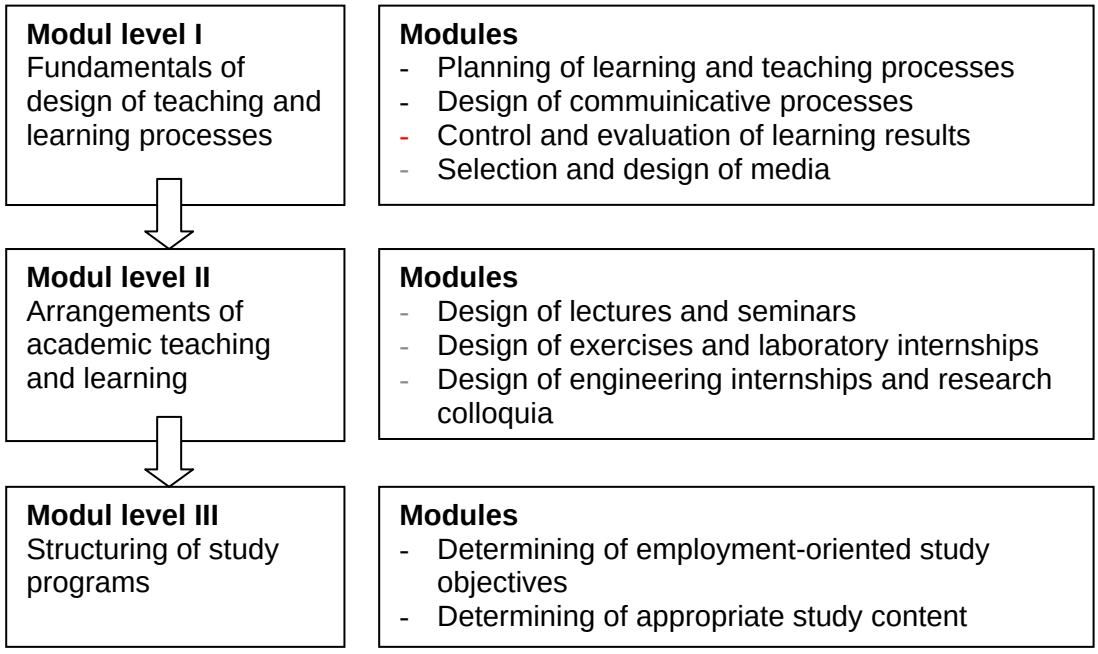
So why not use concepts of engineering education which consider these changes in anthropogenic conditions of the students and which are based on the latest findings of educational and developmental psychology in the design of teaching and learning in higher education? Perhaps the obstacle is the inadequate funding of universities and the resulting poor student-teacher ratio, but certainly also the largely inadequate insight of the teaching staff at universities in these complex relationships of engineering pedagogy.

PROJECT “E-DIDACT“

The starting point of the project, which has been implemented in cooperation of TU Dresden and University of Applied Sciences Zittau/Görlitz since September 2010, is the relationship between teaching quality and student success. This relationship was confirmed by the evaluation of teaching at universities in Saxony [cp. Krempkow, R.; König, K.; Ellwardt, L., 2006]. It is assumed that a systematic, demand-oriented further education in the field of higher education / engineering pedagogy for the teaching staff at Saxon universities will contribute to improving teaching in engineering sciences and therefore the rate of student success.

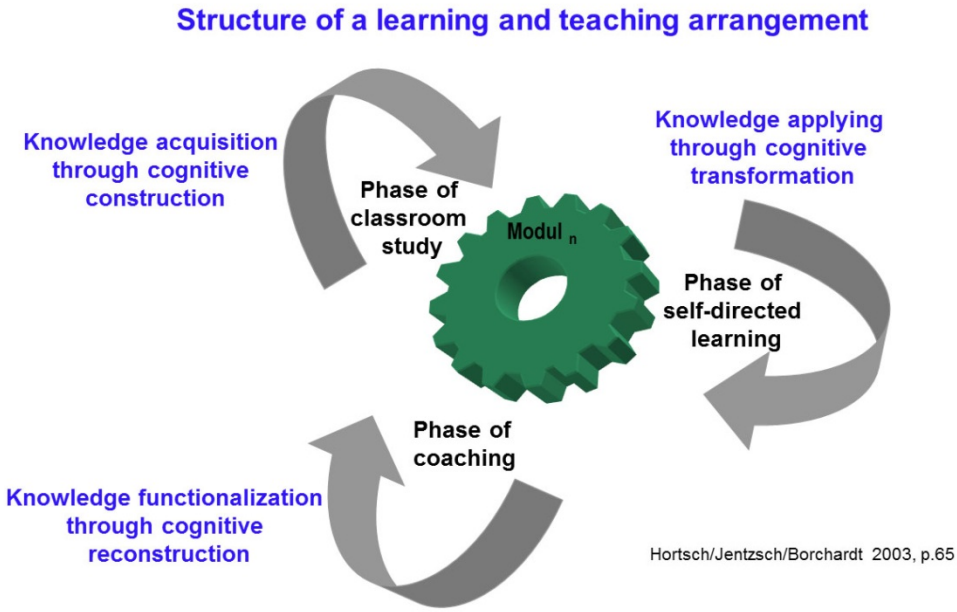
The aim of the project is the development, implementation and testing of a course of postgraduate distance study /further training with integrated e-learning, to develop abilities for designing teaching and learning processes in academic engineering education. The development of postgraduate distance-learning programs is based on the modular structure of the curriculum "Euro-Engineering Educators/Teachers" of the International Society for Engineering Education.

The needs analysis which has already been carried out led to the following module structure of the further training course in engineering pedagogy:



The different module levels are systematically based on each other. All modules are aimed at the development of scientifically-based, application-oriented action rules for the planning, execution and analysis of academic teaching and learning in engineering sciences.

The didactic concept of the training program provides teaching-learning arrangements in coordinated phases of classroom study, self-directed learning as well as individual coaching.



In particular, the phases of self-directed learning and individual coaching are supported by internet-based learning scenarios. The selection of the tools of e-learning is determined exclusively by its didactic purpose and functions.

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