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The acquirement of professional key competences during university studies – an intervention study*

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Abstract—Description of theoretical background and design of a concept for the promotion of professional key competences for computer scientist students.

Key competences; academic instruction; computer science

1. INTRODUCTION

In the past few years universities have started to reflect on quality criteria and the acquisition of key competences. In the scope of the Bologna reform and the reorganization of the study courses into the bachelor and master system, the topic of vocational qualification has become more topical than ever.

In the newly developed bachelor and master study course of computer science at the University of Basel the systematic promotion of social, methodological and personal competences are, next to the technical competences, the main focus.

An accompanying empirical study is carried out with the goal to get more information:

- About the usefulness of the chosen approach
- If the defined competences can be successfully supported
- If university is the adequate place to pass on professional key competences.

2. THEORETICAL BACKGROUND

2.1. Definition of competence

In this paper the term *competence* is used following the notion of Charles Max [1] and Erpenbeck & Heyse [2] who understand competence as a dynamic and process-oriented construct. Accordingly competence is bound to a specific context and contains a planning and active moment of an action. Thus with the notion of competence an individuals' self-organisational dispositions can be paraphrased: competences enable an individual to carry out any dispositions in the defined specific context.

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The most popular way to categorize competences is to distinguish between (1) methodological, (2) social, (3) technical and (4) self competences. It is yet unclear if this is the best way of categorization, as it is very general and stays on the surface. In regards of professional competences it makes more sense to use a profession-oriented classification. For this purpose typical complex situations that occur in the field of a particular profession need to be defined. These complex situations are then analyzed to determine which competences are needed to cope and consist in such situations.

2.2. Aspects of competence development

In order to thoroughly understand the construct of competence and the process of competence acquisition it is important to consider different theoretical constructs. Fig. 1 pictures the theoretical aspects that are taken into account for this project:

There are four major parts giving input for the question of the development of competence.

(1) *The discussion raised by ergonomics and the social sciences.* In the German speaking area a discussion well known under the key word 'Schlüsselqualifikationen' started in the mid-seventies. The idea of qualification was expanded and updated by the concept of competence [1]. The debate on the concept of competence and the definition of competence(s) are the main outcomes. Furthermore many different concepts for training competences, especially in the field of vocational training, were developed and applied.

(2) *Psychology of Learning.* It is not only important to consider definitions and concepts of competence. It is as important to look at the process and conditions of competence acquisition. The research findings on meta-cognition and learning strategies [3, 4] and the research on expertise [5] disclose interesting approaches.

(3) *Didactics.* As soon as a concept needs to be implemented, the question of didactics is of high importance.

(4) *Setting.* This study takes place in the academic sector of education. Higher education and the setting of the university represent the fourth aspect that needs to be considered.

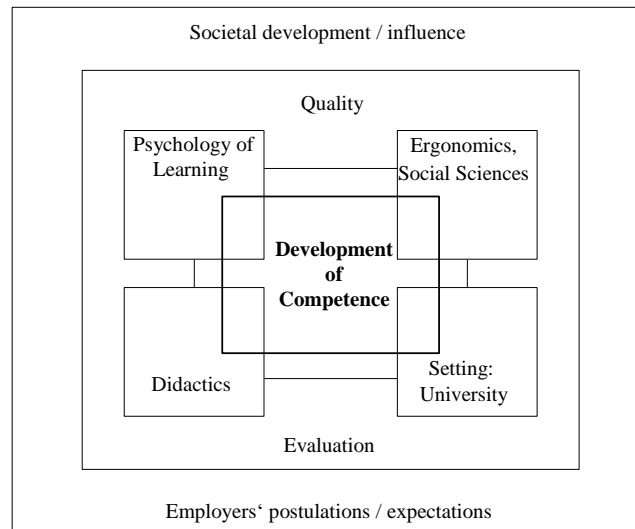


Figure 1. Theoretical aspects of competence acquisition to be considered

Quality has become a very prominent key word in the last few years; also universities have started to consequently evaluate their performance in order to insure a high level of quality. The evaluation is set up according to the definition of quality. In this study the quality of structure, the quality of process and the quality of result will be considered.

2.3. Theoretical conclusions

The theoretical analysis of the notion of competence leads to several implications:

Critical remarks regarding the concept of 'Schlüsselqualifikationen'. The ergonomics and social scientists' discussion on key competences was initiated in the seventies [6] when it was realized, that the current vocational training was not sufficient any more to meet the needs of the professional life. Key competences seemed to be an ideal answer to meet these needs. There is, however, the danger of focusing too exclusively on the needs of the professional world. The function of an educational institution should not be reduced to meet the needs of the employers, but also stay independent – the danger of qualifying instead of educating needs to be kept in mind. In this study the aim is on the one hand to incorporate the needs of the professional world as regards content, on the other hand stay independent and particularly work with methods that foster other, more general values.

Competence development can only successfully be supported with an integrative model. Competence development must happen within and in connection with the field of study: this becomes very clear when looking at findings of cognitive psychological research [3, 4, 7]: As knowledge is always the basis for further development of competence, competences cannot be taught in addition to the rest of the study: the research in the area of transfer and also in expertise show that there is the tendency that the more general and abstract a skill is imparted, the more difficult

is the transfer to a concrete situation. Furthermore findings of the expertise research clearly state that it is the knowledge that makes the difference between an expert and a novice. Using an integrative model not only means to integrate competence acquisition in the curriculum, but goes further: the development of competence stands for an elementary goal, an underpinning value [8] and should be considered in all didactical reflections. When looking for ways how to best implement and support the development of competence, well-established didactical theories can give interesting hints: With the matrix of Schulz [9] and also with Blooms cognitive and affective taxonomies [10, 11] fruitful impulses for a methodological implementation can be found for this new and deepened understanding of an integration of competence acquisition.

Holistic promotion of competence development. Competence should not only be promoted within courses and classes, but also outside of the classroom; learning not only takes place within classes, but particularly in a social context. In this sense the learning environment and the surroundings play an important role. Following the approach of the situated learning [12] the learning environment must be strongly considered when promoting the development of competence.

According to our definition, competence is a construct bound to a specific context and always integrated in an action. A consequent use and implementation of such a definition results in defining a set of standard competences as Oser [13] promotes. For computer scientists working in a very wide and many-sided field, this set of standard is rather general.

3. REALISATION

Following the theoretical conclusions, underpinning values need to be defined. Within this project the underpinning values are:

- Encourage the development of self-organisational dispositions: foster the personal responsibilities.
- Reflexion on the own thinking and learning structures.
- Gather experiences and practice on practical and relevant case studies.
- Open and motivating relationship between students and teachers.

The focus of methods is the implementation of project-oriented training, hands-on-training and tutorials. These elements are integrated in the curriculum within exercises, lectures and seminars. Outside of the classroom web-based portfolios, learning groups and discussion forums are promoted and supported.

As per description, peripheral learning is as important as learning in the classroom. Therefore students need rooms and places to meet, to learn together and to exchange experiences with other students.

In addition, students are offered support courses in learning techniques, writing essays, planning and performing presentations, communication strategies etc.

4. EMPIRICAL STUDY

During the first three years of implementation, the concept is evaluated and observed empirically.

The exploratory focus is to find out, whether within an academic study at a university, competence can be measurably improved applying the described concept.

For this purpose the students of computer science and a control group, consisting of students of computer science at the University of Freiburg i.Br. fill in the questionnaire annually and evaluate the lectures and classes semi-annually. Fig. 2 illustrates the process of the empirical study.

The measuring instrument is composed of different scales:

- The core of the questionnaire is the 'IZK Kompetenzcheck' [14], which was developed at the Institute for Future oriented Competence Development and includes the most common competences.
- The General Perceived Self-Efficacy Scale [15]
- A scale for the identification with the study course
- And the attitude and assessment following the defined standards according to Oser [13].

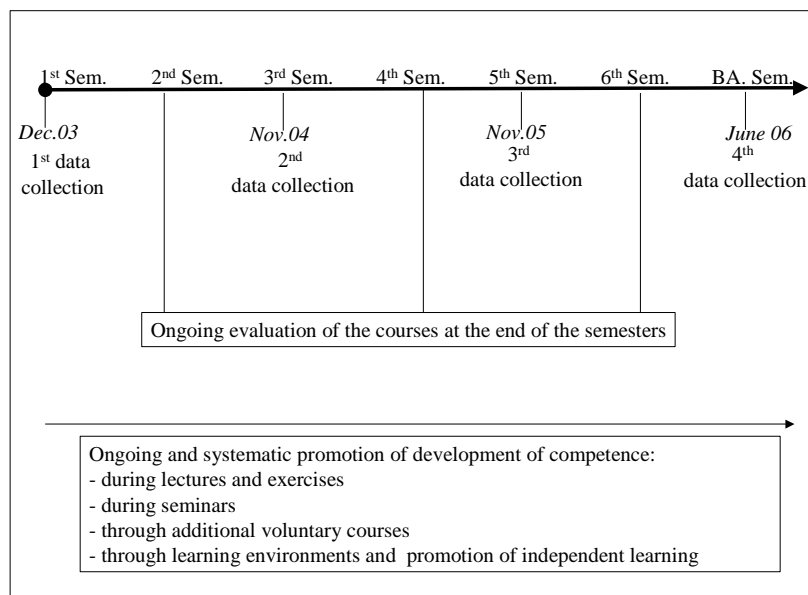


Figure 2. Process of the empirical study

5. CONCLUSION

The experience with the implementation of the concept of competence development so far is very positive. The study is still in progress, the data collection will only be completed in June 2006, so until then there will be no empirical evidence on the effectiveness of the concept.

For the time being there can be stated that a modern curriculum must contain the promotion of the acquisition of key competences, matched to the field of a study

course. Building competence centers to promote general key competences cannot, as shown above, lead to a successful acquisition of competence: competence must always be integrated and adapted to a specific field of study.

The integration of imparting key competences must be done in a way that it is feasible for the lecturers and motivating, supportive and applicable for the students.

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