

Chapter 3

Changing the Curriculum to Problem-Based and Project-Based Learning

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ABSTRACT

Problem based and project based learning (PBL) models are implemented all over the world in various versions at curriculum or course level. Due to this development, the conceptual understanding of PBL has become more diverse and sometimes confusing. This chapter summarizes the conceptual work done by the UNESCO Chair in PBL in engineering education in order to define PBL as a set of core learning principles that can be applied in practice. The PBL learning principles are formulated within three aspects: learning, social, and content of study. Furthermore, the chapter contains a PBL curriculum model, which can be used for analysis and development of the curriculum or single courses. Seven elements are identified as important for the planning and implementation of PBL learning principles, and for each of the elements there are several choices to be made. Finally, the chapter presents concrete advice for utilization of PBL learning principles in the curriculum or in the single course.

INTRODUCTION

The concept problem based and project based learning (PBL) originates from the reform universities established between 1965 and 1974. The concept used by Maastricht and McMaster Universities for the new educational models was problem-based learning, and the concept used at Aalborg and Roskilde Universities in Denmark was problem-oriented and project-organised learning. During the last 40 to 50 years, a lot of

changes have occurred and universities all over the world are now in a development mode. Especially in engineering education, there is a constant need for developing the curriculum according to the technological development and various versions of PBL models have been developed and utilised in order to improve students' learning and achievement of new competences.

To mention a few PBL practices that each have their own characteristics: Stanford University's P5BL model (Fruchter and Lewis, 2003), Olin

College's work with projects, although they do not claim connection with any global community (Somerville et al, 2005), Monterey Tech's implementation of diverse PBL models at different campuses (Lopez-Islas, 2001), the University of Sao Paulo's revised programmes (Ulisses et al, 2009); the University of Queensland (Crosthwaite et al, 2006), Central Queensland University (Joergensen and Howard, 2005) and Victoria University (Ozansoy and Stojcevski, 2009) in Australia have practised project work for many years; the University of Technology Malaysia and University Tun Hussein Onn Malaysia have PBL course modules (Yusof et al. 2005) as do many European Universities such as Aveiro University, Portugal (Graaff and Kolmos, 2007), Université catholique de Louvain, Belgium (Galand and Frenay, 2006; Galand et al, 2010), and universities in the UK such as Coventry University (Bate et al, 2011).

Singling out specific universities is very risky as there is no full overview of all the diverse PBL practices ranging from large-scale to small-scale implementation. The consequence is that PBL practice is getting more diverse and the definition can no longer remain at the concrete curriculum level, but has to become more inclusive and abstract formulated as a philosophy and a set of learning principles (Graaff and Kolmos, 2003, 2007). This chapter will present a new approach to the understanding of problem and project based learning defined by learning principles that allow for variation in the concrete PBL curriculum design at different levels: classroom or institution. Furthermore, the article will address how the implementation of PBL at different levels can be initiated.

PBL LEARNING PRINCIPLES

Due to the widespread use of PBL the specific understanding of the PBL concept has also become fuzzier. Graaff and Kolmos (2003, 2007) argue that there will always be variations in the models

used. Particularly when PBL is used in various educational systems that represent a wide range of subjects, cultures and systems, the concrete models will and must be different. Therefore, it is not possible to define educational concepts by means of concrete educational practices. Instead, models have to be defined by learning principles beyond concrete educational practices and models.

The fundamental learning principles of the McMaster PBL model and the Aalborg PBL model are more or less the same. Barrows (1996) stresses these elements in relation to problem-based learning: the use of problems as a starting-point for the acquisition and integration of new knowledge, new information should be acquired through self-directed learning, it should be student-centred, learning should take place in small groups, and teachers should act as facilitators and guides rather than informants. Illeris (1976) formulated nearly the same elements: problem orientation, interdisciplinary learning, exemplarity of overall educational objectives and teamwork.

Although there are differences at the concrete model level, Graaff and Kolmos (2003, 2007) found that there are common learning principles across the original problem-based and problem-oriented and project-organised practices such as problems as the vehicle for learning, interdisciplinary learning and teamwork. Furthermore, analysis of the origins for Maastricht PBL curriculum model and the Aalborg PBL model (Kolmos et al, 2004) shows that they are more or less based on the same learning theories as those promoted by Illeris (1976), Dewey (1938), Kolb (1984) and Schon (1987). There is no direct link from the learning theories to the educational model level: on the contrary, history shows that ideas, trial and error, theoretical understanding and new experiments developed the models. Based on this analysis, Graaff and Kolmos (2003, 2007) summarised the main PBL learning principles where PBL as acronym stands for problem based and project based learning and is intended to be synonymous with problem oriented and project

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