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Problem Based Learning

Problem-based learning (PBL) is widely regarded as a successful and innovative method for engineering education. Since the development of the PBL model at McMaster University in Canada in the late 1960s, many different varieties have emerged. This paper highlights the Dutch approach of directing the learning process through problem analysis and the Danish model of project-organised learning. Various definitions of the concept PBL identify characteristics at the levels of theoretical learning principles, educational models and educational practices. The McMaster–Maastricht PBL model and the Aalborg model of project work share characteristic features such as the theoretical principle of the problem analysis at the basis of the learning process, integration of knowledge and practice, collaboration and group work. Notable differences were found with respect to the type of assignments, assessment methods and organisation of the group work. In comparison to traditional engineering curricula, the PBL models appear to inspire a higher degree of involvement in study activities and, consequently, a higher level of complex comprehension. A possible drawback is the risk of gaps in specific knowledge areas. Therefore, it is crucial that the students in a PBL curriculum become lifelong learners who have learned to take responsibility for their own learning process.

Understanding the goals and constraints of other disciplines is key to working well in cross-disciplinary projects. Education programs rarely offer learners the opportunity to participate in authentic project-based cross-disciplinary collaborations in a global teamwork e-Learning environment. Problem-, Project-, Product-, Process-, People-Based Learning™ (P5BL) is an approach that has been developed to address this issue. This paper presents mentoring models in cross-disciplinary teamwork learning experiences developed in Stanford University's P5BL program. It addresses the Architecture/Engineering/Construction (A/E/C) industry's need to broaden the competence of engineering students to utilize the acquired theoretical knowledge and understand the role of discipline-specific knowledge in a multi-disciplinary A/E/C P5BL learning environment. Mentoring opportunities are presented within a situated and constructivist perspective on learning, to explore the theoretical constructs and practical implications of developing communities of practice that reach beyond the university walls.

The present investigation aims to describe and analyse aspects of students' experiences of PBL within three different academic contexts: computer engineering, psychology and physiotherapy, respectively. A sociocultural perspective was outlined as a theoretical point of departure. Altogether 58 students participated in the study. Semi-structured interviews were used as the method of data collection. Data were analysed qualitatively. The results showed differences between how problem-based learning is realised and understood by the students in the three programmes. These differences are discussed in relation to the perspectives of knowledge and learning embedded in the programmes, as reflected through the students' experiences.

Entire undergraduate programs have been known to adopt PBL. This might be considered a 'macro-application' of this pedagogical approach. Sometimes micro-scale applications can be useful, i.e. introduction of a single challenging and rather open-ended problem. The problem selected should be generic in nature and rather difficult because to promote learning by the mere mimicking of specific examples is poor pedagogy. Micro-to-meso-scale PBL initiatives have a number of advantages: they familiarise faculty with the PBL approach, they have lower cost and risk, the tutors start at an appropriate position on the PBL learning curve, and they are administratively simple. A comparison between the activities of Engineering Design and Process Modelling is presented. The PBL exercise described herein was developed around a set of linear reservoirs that were specially constructed to provide the students with a hands-on verifiable experience with mathematical modelling. This physical cascade system is unique in that an exact analytical solution exists for the n^{th} reservoir. The degree of success with this modelling exercise is discussed.

Project-organized problem-based learning is a concept that has been successfully utilised for on-campus engineering education at Aalborg University. Recently, this 'Aalborg concept' has been used in networked distance education as well. This paper describes the experiences of two years of Internet-mediated project work in a new Master's degree in Information Technology. The main conclusions are that the project works as a strong learning motivator and enhances peer collaboration, for off-campus students as well. However, the concept cannot be directly transferred to off-campus learning. In this paper, the main problems experienced with group-organized project work in distance education are described, and some possible solutions are listed.

This paper presents a tool for assessment of engineering skills and knowledge, based on a model of taxonomic classification. The tool methodology is built on previously published research and usage in the area of human performance measurement. The paper presents the development of the classification and its application in a comprehensive problem-based learning program in the School of Engineering at Stanford University. Examples are given to illustrate how the tool can be used to communicate the skills, create a common language and foster the creation of trust in teams within the PBL environment. The paper goes on to describe additional usage by faculty, students and industry practitioners in education and career planning.

This paper deals with a PBL approach used to bridge a teacher-centered learning to a student-centered learning. It has been applied in undergraduate and graduate courses of robotics and manufacturing systems with successful results. A cognitive analysis of the relationships between abilities and the steps to solve problems has been carried-out to follow the actual behavior of the students during the evolution of the course, as compared to the assumed one. Our goal was to maintain a permanent challenge among the students that allows them to discover the relevant aspects related to understanding, stating, representing and solving real world problems.

Institutions of higher learning are expected to design their programmes to meet the needs of industry to ensure that students acquire the skills, both technical and non-technical, that will be used in future employment. Thus academic institutions have to develop teaching strategies to meet these demands. This paper presents a strategy in teaching, utilising the problem-based learning approach, which allows for the development of non-technical skills in a civil engineering core subject. The teaching strategy is based on the assumption that, by using the active knowledge base in a particular subject with specific application strategies, both technical and non-technical applicable skills can be developed in an integrated manner. An example is provided to illustrate the teaching strategy, and student perceptions of the strategy are also presented.

This paper shows the results of testing the effectiveness of a constructivist model called ABC^2 in a chemistry class for engineering majors. Its success was measured using qualitative and quantitative techniques (e.g. observation, interviews, tests and final projects). The results were then compared with a traditional teacher-learning model employed by a separate university, which employed experimentation and control groups to test students' ability to solve problems.