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A PERSPECTIVE IN ENGINEERING EDUCATION USING PROJECT-BASED LEARNING

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ABSTRACT

Engineering Education is certainly a very important topic. However, as engineering practice exists since the first steps of mankind, man begun to be engineers much before a formal acceptance of the fact occurs. With this statement we want to say that engineering is hard and soft, a mixture of hard rules and models, basic sciences, with context dependant behaviour, organizational rules, social dependencies and people emotions. Besides, engineering practice is something that is always evolving in a dynamic faction, in contours of blurred definition [1], which implies that the body of knowledge that supports it is always reconstructing itself. Strategies for engineer education are manifold and the only problem seams to be that along the years we tend to adopt the more classic ones, which sometimes are the most ineffective, a problem of the dominant design concept [2]. And the fact is that escaping from the dominant design always implies a paradigm shift [3]. Here a shift from teacher presenting to student own work. Within the broad area of Engineering Education we in this paper and in our own research are much focused in engineering project education. How can we provide better project approaches [4], integrating technology and social, how can we extend the abilities of our engineers?

In engineering master courses that are structured to have a topic on Project (normally associated with the master's dissertation) students use to develop a kind of report, a small dissertation. Having in mind that future engineers should enhance their sociotechnical abilities, we designed a course strictly based on project-based learning. Our results are very interesting in the domain of integrating technology and business. By observing what relevant communities in engineering schools do, namely academics in a broad sense, teachers, pedagogical and scientific board elements, students; also by reflecting on the experiences of academics and researchers through published papers in top international journals; and finally by distilling our own experience we are able to construct theory and deploy some reflections and recommendations. With that purpose in mind we designed a case study as a strategy of research, and we used bibliographical analyses over public data published in top international journals to animate our reasoning's and assert our recommendations. With this approach we are able to extend some practices, as we are able to recommend some behaviour culture-based attitudes. Our "abstract" has only two sections after this introduction. In the first one we try to make explicit why we used project-based learning and in the other we make a very general description of the case study we mounted to support our research. In fact many others aspects are considered, but they can only be explored and detailed in the extended version of this paper.

The goal of our research is to make explicit a specific paradigm, an integrated way of looking into engineering practice and engineering learning, using project development approaches involving technologic artefacts, social habits and emotions, mainly considering them all

sociotechnical things playing together. The main advantage of our proposed approach is that learning occurs by doing and, we would say, more importantly, learning occurs almost as a sub-product of doing, almost without explicit notice from the students, as they are mainly engaged in achieving results. And achieving results they learn quite a lot! In fact there are mixed goals in our approach. One is performing and obtaining results in engineering project design and development. The second one is a by-product of that, and it is learning, enriching its own dynamic capabilities, and internalizing tacit and explicit knowledge about the work experienced. Of course the effectiveness of our model resides in the alignment of the two goals, which implies mature staff and motivated students.

Our project courses usually have from 6 to 50 students and we divide them by groups of three or four students each. The way groups are formed is important, for example in each group we should explore diversity, if two close friends are in the course they should belong to different groups. Also the number of students per group is important. Two is short, and something between three and four looks ideal for the kind of task we deal with, a semester work in 6 ECTS Project course. General literature on PBL stresses that there are three key success factors: students should produce multiple evolutionary drafts, incorporate frequent peer critique, as well as expert advise, and performance should culminate with a public presentation, with explicit questions and answers, discussion and assessment. From these recognised success factors we draw some extensions considered very important. One is collaboration between concurrent student groups [5]. A specific plot should be mounted in order to explore this collaboration [5,6]. We namely use the first steps of the project evolution to provide a kind of state of the art about the problem under study, in this step collaboration is more then suggested. On further steps of the project we promote competition but we always suggest students keep on collaborating. We need to say that all groups address the same project, eventually two different projects at most. One other extension of our approach is assigning roles and other is explaining the rules, even better, helping in designing the rules within the course community. Another extension is to create an ongoing lessons learned processes, inviting students to debate about what they are doing and discovering and defying them to suggest ways of “fixing” this created knowledge for collective use of the extended community. And finally we should explore specific exercises of student’s co-assessment, with almost their full responsibility, always exploring their empowerment.

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