Chapter 6
A Project–Based Learning Approach: Developing Mathematical Competences in Engineering Students

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ABSTRACT

Mathematical applications have a presence in an engineering environment; in the particular case of mathematical models. A pedagogic theoretical framework that supports various teaching-learning techniques is constructionism; one of these techniques is called Project Based Learning which provides several advantages. This chapter aims to show the experiences during the course of Mathematical Modeling in a context of project-based learning. It will show that students develop general skills of engineering which includes developing the faculties of memory, reasoning and problem solving, teamwork and initiative and of readiness to take risks. Also presents some of the advantages and issues for consideration in relation to its effectiveness as a teaching and learning method.

INTRODUCTION

Historically, education has responded to different types of societies. Before the 1970s, most of the industrial products and equipment such as machine tools, manufacturing equipment, and home appliances were mainly based on mechanical principles with very few electrical and electronic features. But there was a change in the technology of these products as an increasing content of electrical and electronic system was integrated with the mechanical parts of the products. Changes in the working environment have modified skill demands for many jobs. Work environments today are based on specialized technology and multidisciplinary teams are needed to face them. The job market is moving away from simple...
jobs. Education faces a new challenge: To provide the engineers with information skills needed in a technological society. The pressure on education systems to teach these new skills will intensify (Griffin, McGaw & Care, 2015).

The conjunction of mathematical knowledge, skills and values through technology is important and can be achieved by working with the educational process of mathematics. To do this, it is necessary to analyze how the teachers and students manage knowledge for training and development. The competence of managing mathematical knowledge favors the mathematical learning, education values and development of the student. The educational process of mathematics is represented as a process of knowledge management. The mathematical activity that develops the student into a socio-cultural context, with primarily knowledge among key factors that are managed and incorporated to obtain an essential function, generation, use and communication of such knowledge. Therefore, integration of knowledge, skills and values can be achieved by working from the educational process of mathematics through the formation and development of management competencies of mathematical knowledge, which in turn favors the mathematical learning, education values and development of the student.

Traditionally, to solve mathematical problems in engineering the use of pencil, paper, and a scientific calculator was enough. However, in this century, new technology has displaced scientific calculators (Quezada-Espinoza & Zavala, 2014). New components such as computers and mobile devices are becoming more common. Furthermore, there is specialized equipment for engineering specific areas that were previously in science labs, and today due to their low cost, are coming to school and can even be purchased by students, such as Programmable Logic Controllers, FPGA cards, Data Acquisition boards, sensors, actuators and many other devices (Samanta & Turner, 2012).

It is true that technology is not the solution to the problems of teaching and learning mathematics, but it represents a great opportunity for engineering students to acquire knowledge that is meaningful in their professional lives by providing new ways to interact with mathematical concepts through technological resources (Wake, 2014).

The concept of competence focuses on learning outcomes, on what students can do at the end of their educational process and procedures that allow them to continue learning autonomously throughout their life. Engineers who have professional competence have the knowledge, skills and attitudes necessary in the industry (Lunev, Petrova & Zaripova, 2013). If they focus on the desired outcomes of particular work roles, they will see very readily that the implementation of skills depends on social context. It is not sufficient to learn academic, technical or vocational skills assuming that all resources and technologies are known and constant. This is a dynamic and a technologically complex world, where it is not possible for any one person to manage complex tasks alone.

**LITERATURE REVIEW**

**Constructionism and Project Based Learning**

In the 1980s Seymour Papert delivered the following speech by video to a conference of educators in Japan:

Constructionism means giving children good things to do so that they can learn by doing much better than they could before. Now, I think that the new technologies are very, very rich in providing new things for children to do so that they can learn mathematics as part of something real. (Papert, 1980)
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