

Chapter 15

Promoting Cognitive Skill among Engineering Undergraduates with Technological Software

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ABSTRACT

This chapter reviews the infusion of technology tools such as the integration of computers into programs like simulation to promote higher cognitive skills among engineering undergraduates. With the constant change of technology and education, it is necessary to refine the current teaching and learning process to not only promote understanding but also to create room for engineering undergraduates to process the information with higher-order cognitive skills. The authors examine the evolution of engineering education against the backdrop of the problems faced in the learning environments and the technological trends in engineering curriculum. To this end, the authors propose strategies to promote higher-order cognitive skills among engineering undergraduates based on the evolution of technology in engineering as well as the challenges faced in the implementation of such tools in teaching and learning.

INTRODUCTION

Cognitive skill is a human's ability to manage and sort out thoughts or the ability to learn new information, understanding written materials and remembering the materials (Wikipedia, 2013). According to Dr. Michelon (2006), this is the brain-based ability that we have, to carry out any task

ranging from simple task like the '1+1' calculation to the most complex scientific discovery. Hence from the day we were born, everyone is equipped with the cognitive skill but the capacity of such skill varies from one to another. The cognitive skills are not constrained to the knowledge we learnt, but it is how we learn, remember, understand and apply the knowledge learnt.

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For example, in answering a phone call, it involves perception (hearing the ring tone), decision taking (answering or not), motor skill (lifting the receiver), language skills (talking and understanding language), social skills (interpreting tone of voice and interacting properly with another human being), (Michelon, 2006). These tasks are not something that one follows blindly from the textbook but it's a task that is understood and applied in our daily life.

The cognitive skill plays a significant role in carrying out our daily life activities and as well as in the field of education. Study by Kerckhoff, Raudenbush and Glennie (2001) shows that educational attainment and cognitive skill are closely linked together. The ability of one to learn, understand and apply the knowledge taught in class to other domain is heavily dependent on their cognitive capabilities in processing it in their brain. Some will take a longer period to understand the subject while others will take minutes to put the knowledge learnt in action.

From what has been said to this point, it can be deduced that cognitive skill is important in learning. Hence the important of the cognitive skill in engineering field will be discussed foremost in the paper, to give an overview of how important the skill set is to produce a competent engineer. In the next section, it will then followed by the problems arose from the incapability in achieving higher cognitive skills and how technological tools have used and applied in education to improve the state of affair.

ENGINEERING EDUCATION BACKGROUND

In 2009 the introduction of the Outcome Based Education (OBE) into the engineering programs by the Board of Engineers Malaysia (BEM) has made all engineering programs in Malaysia like civil engineering, electrical and electronic engineering and as well as mechanical engineering

programs to be OBE compliance in order to be get full accreditation from BEM.

According to Spady's words, "OBE system means starting with a clear picture of what is important for students to be able to do, then organizing curriculum, instruction, and assessment to make sure this learning ultimately happens accordingly." (Spady, 1994) The outcome of OBE refers to "what learners can actually do with what they know and have learned – they are the tangible application of what has been learned." (Spady, 1994) In other word, OBE system focuses on how well can engineers apply their knowledge learned in their domain like how well does a mechanical engineer uses their knowledge learnt in class to design physical engines and machineries.

Hence, Bloom Taxonomy was developed in 1956 by Benjamin Bloom to measure and categorize the Outcome-Based Education (Eisner, 2000). Bloom Taxonomy is the classification of one's cognitive skills according to the 2 categories which is lower and higher order cognitive skills. The categories are further broken down into six different cognitive levels. The lower order cognitive skills are remembering, understanding, applying, and the higher order cognitive skills are analyzing, evaluating and creating. Each level can be depicted as shown in Figure 1.

Each of the level represents the ability of ones in applying their knowledge learnt to other domain. Level 1, "Remembering" is where undergraduates are able to recall the terms or information that lectures have conveyed in class. According to (Bloom 1), this can be tested by defining a term or know the safety rules of the subject taught. Level 2, "Understanding" ensures that undergraduates are able to comprehend the meaning of the instructions and problems. Explaining the complex instructions with one's own words is one of the exercises to be done for this level. Level 3, "Applying" is by using the theory learnt in a new novel situation, for example, evaluating the reliability of written test with the statistical laws. Level 4, "Analyzing" is to separate information

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