Available online at www.sciencedirect.com

ScienceDirect

Procedia Social and Behavioral Sciences 18 (2011) 255–259

Procedia Social and Behavioral Sciences

Kongres Pengajaran dan Pembelajaran UKM, 2010

Systematic Infusion of Creativity in Engineering Design Courses

Juridah Johari[a], Dzuraidah Abd Wahab[a*], Jaafar Sahari[a], Shahrum Abdullah[a], Rizauddin Ramli[a], Ruhizan Mohd Yassin[b], Norhamidi Muhamad[a]

[a]*Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor Malaysia*
[b]*Faculty of Education, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia*

Abstract

Earlier studies have shown that the level of creativity of the fourth year students of the Mechanical Engineering and Manufacturing Engineering Programmes at the Universiti Kebangsaan Malaysia are low to average, as reflected in the evaluation of their group based design projects. Based on the finding for the next cohort of students, several creativity techniques are introduced in the course such as mind mapping and combined with the conventional techniques in design engineering which includes Morphology analysis and Pugh Evaluation matrix. Students are required to apply the techniques and report the implementation in their log books. It was observed that the students are more creative and able to propose ideas that are 'out of box thinking'. These achievements showed that the creativity level can be enhanced through teaching and learning. In order to ensure an effective infusion of creativity among students in the Mechanical Engineering and Manufacturing Engineering Programmes, it is proposed that the students are exposed to effective creativity techniques combined with the standard engineering design methods for generating ideas. Students should be introduced to the creative techniques through design-based courses from their first year at the university.

Selection and/or peer-review under responsibility of Kongres Pengajaran & Pembelajaran UKM, 2010

Keywords: creativity; engineering design courses; mind mapping; design techniques;

1. Background of Study

Preliminary studies by Jaafar Sahari *et al.* (2009) and Syazrin Aklili *et al.* (2009) on students' creativity in the Mechanical Engineering and Manufacturing Engineering Programme has found that the creativity level of students is relatively low as reflected in their inability to generate ideas that are 'out of the box thinking'. However, the study also leads to new findings that individuals' creativity can be enhanced by learning and applying creativity techniques in their work. Previously, Syazrin Aklili *et al.* (2009) have studied two cohorts of students taking the Product Design course (KP4273) and it was found that there is an increasing capability in generating ideas for those who have been exposed to the creativity enhancing techniques like brainstorming, mind mapping and the conventional techniques. From the study, a proposal has been made to review the design-based curriculum for both programmes and propose suitable methods to foster the creativity in a systematic and structured manner starting from their first year. According to Stenberg (1999), the engineering curriculum provides exposure to the problems

* Corresponding author. Tel.: +0-603-8921-6455; fax: +0-603-8925-9659.
E-mail address: dzuraida@eng.ukm.my.

1877–0428 © 2011 Published by Elsevier Ltd. Open access under CC BY-NC-ND license.
doi:10.1016/j.sbspro.2011.05.036

that can develop students' creative thinking skills. Creativity in the context of engineering design is related to problem solving and cognitive activities. This study will explore the engineering design curriculum issues and how to foster creativity systematically in the learning curriculum.

2. Methods of Study

Kemmis & McTaggart (1982) defined that the research are conducted based on the framework of the design action research. The main features of action research are to improve practice. Practice in this research context is the teaching and learning practice that can enhance creativity through the design courses of the Mechanical Engineering Programme and Manufacturing Engineering Programme in the Faculty of Engineering and Built Environment (FKAB), Universiti Kebangsaan Malaysia. The phases of action research are as follows (Jaafar *et al.* 2010):

i. Planning.
ii. Action.
iii. Observation.
iv. Reflection.

These four phases form a complete loop and the loop can be repeated until the researcher is satisfied with the results of observation and reflection of the actions planned and implemented for each loop. In the planning phase, reflection can be used to identify problems that arise in the current practice. In this study, the identified problem is the inability of students to generate creative ideas as reflected in the medium to low scoring on creativity. Thus the lecturers plan to introduce an approach to brainstorming and mind maps. Action phase is where the lecturers implemented the approach and evaluate the effectiveness of the actions. In the reflection phase, the lecturers analyzed data obtained through observations and assessments. Results of the reflection is used in the planning of the next loop should there be any gaps between the findings and the targets. This paper is focuses on the findings for the first loop only.

3. Design-Based Curriculum

For both The Mechanical Engineering programme and Manufacturing Engineering Programme, design-based courses are not taught in every semester. Table 1 shows the lists of design-based courses by semester for both programme (FKAB Undergraduate Handbook, Academic Session 2009-2010).

Table 1. Design-based course according to semester

Semester	Mechanical Engineering Programme	Manufacturing Engineering Programme
1	-	-
2	KF1174 Engineering Graphic	KF1174 Engineering Graphic
3	-	-
4	-	-
5	KJ3934 Design of Machine Components	KP3214 CAD/CAM
6	KJ3944 System Design	-
7	KJ4955 Design Project	KP4274 Product Design
8	-	-

From Table 1, it is clear that students began to be exposed to design-based courses starting from the fifth semester. Upon completion of the Engineering Graphics courses in year 1, students are no longer exposed to the design-based courses until they are in the fifth semester. For example, in the Mechanical Engineering Programme, design concepts are introduced in the Engineering Graphics course. The learning outcomes of the Engineering Graphics course include understanding the formation of the basic geometry design. Students are also expected to be capable of developing multi-view and section view drawings. In the fifth semester, students will have to enrol for the Component Machine Design course in which the learning outcome is an understanding of the concepts of Mechanical Engineering Design and safety factors. In the following semester, students taking the Systems Design course are required to design a set of mechanical components together with the complete system. Finally in Design Project course, the students are required to use all the basic sciences and engineering fundamentals to perform