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OEL Implementation in Sustainable Engineering Education

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Abstract

In developing countries such as Malaysia, science and technology play a vital role in modernization and industrialization. Therefore, there is an immense need of improvement in service management for science and technology education to emphasize various course delivery methods at higher learning institutions rather than merely on conservative measures in order to be able to produce proactive and self-independent students. This study assesses the impacts of Open Ended Laboratory (OEL) to Diploma in Civil Engineering students in general and investigates its effects on students' performance in a university in Malaysia. Comparison was made on three different branches i.e. Branch 1 (Sarawak), Branch 2 (Penang) and Branch 3 (Pahang). With a view to improve the conventional laboratory, OEL provides a more relevant technique to produce a competent engineer as it critically examines the core element of openness in experimental work. In OEL, students are given responsibilities to explore and design their own experimental work to solve a problem. Five different engineering laboratory courses were analyzed accordingly to its cognitive, psychomotor and affective domains. It is found that there are many broad issues that can be brought up particularly when the faculty has just introduced the implementation of OEL in June 2013. Results show that there is a similar trend on the impacts of OEL to all branches which highlights the uniformity between faculties in branches. Closing the Loop (CDL) GPA indicator for five courses has dropped upon the implementation of OEL except for one course in Branch 3. In Branch 1 particularly, 1 of the 5 courses shows a decrease in percentage of getting a grade A but overall, the students show that they are able to adapt with the changes. It is certain that the element in OEL does help them to stimulate their learning environment and able to replace the conventional method, which is no longer adequate to fulfill the requirement in the industry. This also shows how important it is for the faculties and academicians to keep improving their service quality through improvisations to help produce a better quality of graduates as the university main product.

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1. Introduction

Conventional laboratory work is known to be prescriptive and passive as it is fully guided from start to finish. With the advanced role of engineers nowadays, this method is no longer adequate to fulfill the requirement and standard set by Engineering Accreditation Council (EAC) (Hafizah et al., 2012; EAC, 2012). The faculties and academicians need to improvise their approach to provide a better service and produce high quality of graduates.

Static assessment such as the conventional laboratory is considered to be detrimental and will cause students to lose interest in laboratory courses (Othman et al., 2008; Riza & Kamarudin, 2012; Shahrizan et al., 2012). Students need a comprehensive assessment in their laboratory work that complements all engineering theory. They need to be more dynamic and must be able to design, lead, conduct, analyze and interpret data, thus preparing themselves for a more challenging, real life engineering problem.

Today's modern education system should emphasize on independent learning (McBride & Bonnette, 1995). This is the reason for introducing OEL in the faculty back in June 2013. The different level of openness in OEL will allow the students to complete their tasks with a more flexible, but guided instruction. It is believed that this approach will help to develop various skills for the students including leadership, management, communication and critical thinking while nurturing creativity and innovation within them (Noorhisham et al., 2012). However, the effectiveness of OEL in Diploma in Civil Engineering in Malaysia has never been reviewed extensively, particularly from the point of view of each course where different approach may be taken that leads to various results. The main goal of this study is to assess the impacts of OEL on students' grades and course GPA in five laboratory courses for five continuous semesters upon implementation of OEL.

2. Laboratory activities

Conventional laboratory is believed to be limiting the critical thinking and reasoning skills of the students (Norliza et al., 2012). It also reduces the opportunities for them to explore the experimental set up and the relation with real life engineering problem. They will become too rigid in learning and unable to expand their knowledge.

The OEL assessment is separated into common test, practical test and group and individual report writing. This completes all the domains of cognitive, psychomotor and affective in Bloom's Taxonomy (Ali et al., 2014; Narita et al., 2014). Laboratory activities will be based on the level of openness that is determined by the instructors and categorized into level 0, 1, 2 and 3. The level of difficulty is increased accordingly to the level, as shown in Table 1. This is to gradually guide the students to work independently.

Table 1. Scwab / Herron level of laboratory openness.

Level	Problem	Ways & Means	Answers
0	Given	Given	Given
1	Given	Given	Open
2	Given	Open	Open
3	Open	Open	Open

3. Methodology

This study was conducted among students of Diploma in Civil Engineering programme in a Malaysian university in three branch campuses namely: Branch 1 (Sarawak), Branch 2 (Penang) and Branch 3 (Pahang). Data acquisition and research analysis were carried out based on the achievement results before (semester December 2012 – April 2013) and after (semester June – October 2013) the implementation of OEL for all branches. The study involved five different laboratory courses. Course 1, 2, 3 and 4 are offered in semester four whereas Course 5 is offered in semester five throughout the three years program. Sample of students were taken from different batches and results of students' achievement were expressed in percentage. This study analyzed the students' grade attainment and Closing the Loop (CDL) GPA.