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THE USE OF INDUSTRIAL VISITS TO ENHANCE LEARNING AT ENGINEERING COURSES

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Abstract

Industrial visits represent an important activity in any engineering undergraduate programme that contributes to the achievement of various essential learning outcomes and programme objectives. This paper reports on an attempt to make the industrial visit an integral part of the Engineering Design and Communication course. This is achieved through identifying learning outcomes and a suitable industrial site to achieve them. For this purpose a thermal power plant was indentified as a site to be visited by students. The visit was planned to help students to achieve the learning outcomes. A number of questions in form of surveys, related to the learning outcomes, were prepared and given to the students to answer. The pre-visit, after-visit, and post-visit surveys were aimed at priming the minds of the students, gauging the level of satisfaction, and assessing the level of retention of knowledge, respectively. Students found this method very useful and they were able to remember a fair bit of information after about semester from the trip date. Our assessment of this exercise is the objectives have been achieved.

Keywords: Engineering survey, Learning outcome, Outcome based education, Industrial visit.

1. Introduction

Outcome Based Education (OBE) is an educational model that emphasizes on what students know and are able to do at the end of the programme. Decisions on teaching and learning are made based on how best to facilitate the desired outcome which in turns leads to planning process that is different from traditional educational planning. In OBE, the desired outcome is first identified before the curriculum is created to support the intended outcome [1, 2].

Several universities routinely conduct industrial visit as a part of their curriculum. The validity of visit as an instrument to measure program effectiveness depends on several factors. Since 2005, School of Engineering, Taylor's University College (TUC), Malaysia has conducted a course "Engineering Design & Communication" for first year/first semester students for all disciplines which includes Chemical (CE), Electrical and Electronics (EE) and Mechanical Engineering (ME) students. The aim of this course is to introduce the concept of Project Based Learning (PBL) in the engineering. The concept of learning outcomes in engineering is to include or improve the student's technical ability and knowledge, ability for life long learning, leadership and team work ability and communication skills for sustainable development [3]. This led to a transformation of engineering education from being teacher-centred to student-centred with initiatives [4, 5].

Al-Atabai and Al-Obaidi [6] achieved a unique approach to the use of the Project Based Learning to transform the curriculum into CDIO curriculum through the use of carefully selected projects for the Engineering Design modules (which are Project Based by nature) and use these modules as platforms to encourage practical engagement in other concurrently offered modules which are traditionally viewed as theory based modules. The purpose is to ensure that the required objectives are effectively achieved.

With the core purpose of TUC being to educate the youth of the world to take their productive place as leaders in the global community, all programmes at TUC have ongoing Program Learning Outcomes Assessment to ensure that curricular objectives are aligned with the educational institution purpose and that students are achieving the learning outcomes.

Student centered learning whereby students learn from the theories and PBL which emphasizes on the hands-on approach that educators use to approach and solve engineering problems. Under this subject module as an integral part, we planned to experience the industrial environment as a visit. Through the learning outcomes of this industrial trip, one cohort (about 60 students) was guided to a power plant, where students can improve their knowledge and skills based upon the learning outcomes. For our visit we had chosen Jimah, coal fired thermal power plant, in Port Dickson-Malaysia. A group photo at the plant entrance is shown in Fig. 1. To achieve the learning outcomes of this industrial visit we planned to assess the student's technical learning capacity and remembrance by conducting three technical surveys (pre-visit, after-visit and post-visit) at different stages.

2. Learning Outcomes

The visit generally consists of lectures about the company, the site being visited and a range of topics specific to learning outcomes.

- Recognize the process units – Boiler, Pump, Condenser, Steam turbine, Generator, Electrostatic precipitator, Pulveriser, Reclaimer and generate the process flow diagram.
- Identify input and output for the process.
- Experience the importance of working safety.
- Understand the concept of thermal energy conversion and estimate overall thermal efficiency of power plant.
- Understand how the product of the power plant interfaces to the world.

Fig. 1. Group Photograph at Jimah Thermal Power Plant.

3. Planning the Visit

The industrial visit planning started by contacting the power plant management and obtaining the plant diagram as shown in Fig. 2 and prepared a series of questions related to the learning outcomes. The students were asked to answer pre-visit questions that are related to the plant diagram. Answering these questions prior to the industrial visit was aimed at priming the minds of the students and providing a mental framework to acquire the intended knowledge. After completing the visit, students were asked to answer another set of questions related to the visit and the power plant. These included questions were aimed to gauging the student's satisfaction level. Students were again ask the same set of post-visit questions 3 months later of the visit in order to assess the level of retention of knowledge.

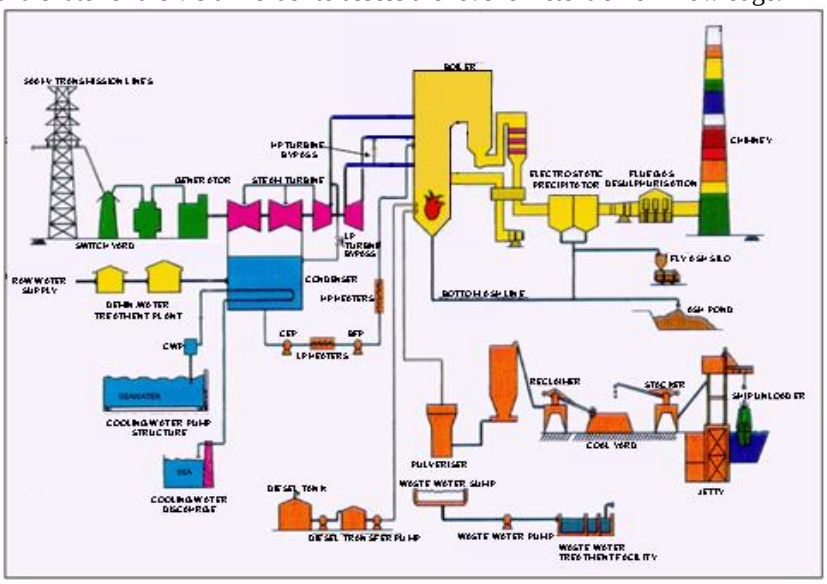

Fig. 2. Process Diagram of Thermal Power Plant.

Pre, After and Post-Visit Surveys

• Pre-Visit Survey

As a start of the industrial visit, the process flow diagram (Fig. 2) of visiting plant had been described to students. Students were asked to complete the pre-visit survey containing questions related to the learning outcomes. By answering these questions, students can frame some sort of knowledge about the process, safety aspects, marketing of products, environmental pollution etc. of the industry they visited.

• After-visit Survey

After-visiting industry, a set of questions had been given to the students, in order to assess their understanding from what they learned. This after-visit survey motivated the students to learn and ask more questions related with their survey which is based on their learning outcomes.

• Post-visit Survey

Post-visit survey was done after 3 months of their industrial visit in order to test students retaining knowledge about the learning from the trip based on learning outcomes. Some set of questions had been given to the students, to evaluate their understanding from the industrial trip education.

4. Results and Discussion

4.1. Pre-visit survey

Figure 3 illustrates the results of pre-visit survey. It had been bound that the students from all disciplines (CE, EE, and ME) gained some information from the initial briefing as approximately 48%. This indicated that the students still required knowledge about the activity. This was because, the students as they are first year/first semester in the early stages of learning about the thermal power plant process. Therefore the purpose of pre-visit survey was to stimulate the students to learn more about their subjects based upon the industrial visit learning outcomes and to look for answers from the industry experts.

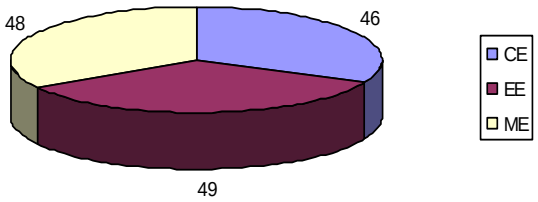

Fig. 3. Pre-Visit Survey Results for all Disciplines.

4.2. After-visit survey

After performing the industrial visit, a modified version of the pre-visit survey had been given to the students to assess their understanding from what they

learned. The results indicated a significant increase in the student knowledge compared with pre-visit results. In addition to that, the survey motivated students to learn in detail about their subjects. Figure 4 illustrates the results of after-visit survey for all disciplines students.

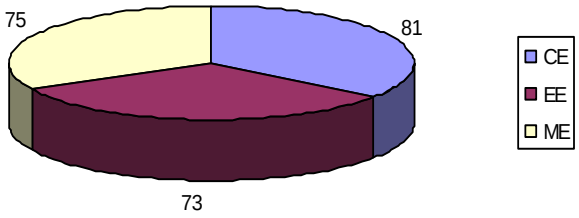

Fig. 4. After-Visit Survey Results for all Disciplines.

4.3. Post-visit survey

The results obtained from post-visit survey (Fig. 5) shows that most of the students still retain their knowledge. A comparison between pre-visit and post visit shows approximately more than 40% increase in gaining knowledge about the process of thermal power plant from the learning outcome based survey given approximately 3 months later. This results show that students can retain the subject knowledge forever when they learned their subjects based upon the learning outcomes.

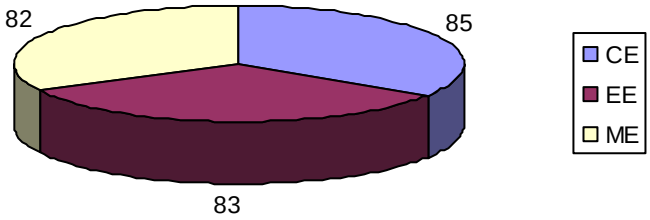

Fig. 5. Post-Visit Survey Results for all Disciplines.

4.4. Overall results

4.4.1. For individual disciplines

From the results (Fig. 6), students gained some knowledge from their pre-visit survey to post-visit survey based on the industrial visit learning outcome. From Fig. 6, we can conclude that the purpose of learning outcome had been achieved.

4.4.2. For individual learning outcomes

Figure 7 shows that the students more or less achieved their individual learning outcomes through the industrial visit from their pre-visit (beginner) to post-visit survey (knowledge retaining).

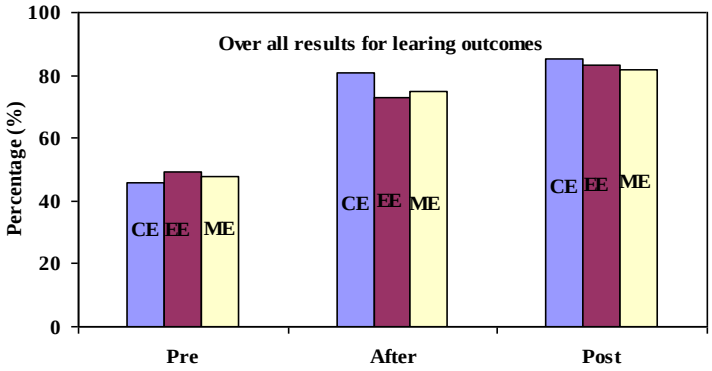

Fig. 6. Overall Survey Results for Individual Disciplines.

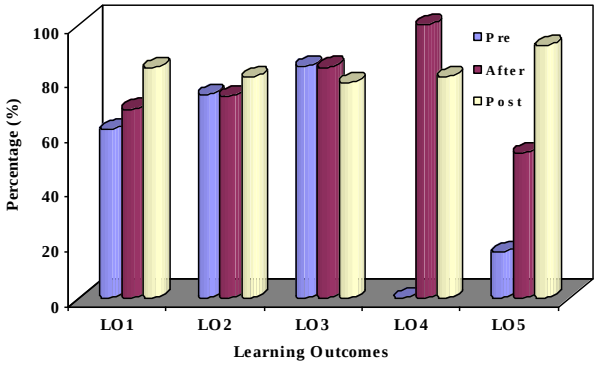

Fig. 7. Overall Results for Individual Learning Outcomes.

5. Conclusions

Industrial visit survey provides the students and programs with "dynamic" real time feedback that is very useful in the program learning outcomes process. It enables educational institutions to build close ties with industrial experts and also to achieve the learning outcomes to students. Several broader educational partnerships have emerged as a result of these visits. These include student's internships, funded research projects, curriculum development, student career opportunities. Moreover students will gain the subject learning outcome by means of pre, after and post industrial visit surveys. This has resulted in enhanced visibility for the students among their learning outcomes and their portfolio.

Acknowledgment

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