CONTINUOUS ASSESSMENT ON PROGRAMME OUTCOMES OF CHEMICAL AND BIOCHEMICAL ENGINEERING BASED ON STUDENT’S FEEDBACK

NUR TANTIYANI ALI OTHMAN1,*, DARMAN NORDIN1,2, SITI ROZAIMAH SHEIKH ABDULLAH1, ROSIAH ROHANI1,2

1 Department of Chemical and Process Engineering,
Centre for Engineering Education Research
Faculty of Engineering and Built Environment,
Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia
*Corresponding Author: tantiyani@ukm.edu.my

Abstract

In the outcome based education (OBE) system, to ensure the targeted learning outcomes achieved at the end of each course, continuous improvement on the learning and teaching process is necessary. This study was conducted to evaluate the performance of students through the achievement of programme outcomes (POs) for Chemical and Biochemical Engineering students during their four years of study at the Department of Chemical and Process Engineering (JKKP), Faculty of Engineering and Built Environment, UKM. The assessment was conducted by distributing two types of questionnaire to the students during Majlis Mesra Bakal Graduan to get their feedback on the PO and Integrated Project (IP) implementation at the JKKP. The assessment results were compared with four previous academic sessions. The results show a slight increase in terms of PO performance and achievement. As well, some improvement has been implemented in the learning and teaching activities such as mentor-mentee program, enhancement in project design and introduction of i-lab poster presentation.

Keywords: Learning process, Continuous improvement, Student feedback, Outcome based education, Programme outcome, Questionnaire, Integrated project.

1. Introduction

Engineering education in Malaysia has started to implement the outcome based learning (OBE) system since mid-2000’s and it is one of the requirements for
recognition of an engineering program by the Board of Engineers Malaysia (BEM). The OBE system solely focuses on the technical and fundamental aspect in the engineering knowledge as well as generic skills such as effective communication, teamwork and professionalism [1]. It is dissimilar with the traditional teaching and learning methods such as lectures, assignments, quizzes and exams, which not able to achieve the targeted learning outcomes of an engineering programs that required by the Engineering Accreditation Council (EAC) [2]. Still, OBE’s implementation is quite a challenge to the educators in the engineering area to achieve the targeted learning outcomes. To face this challenge, the engineering’s educators need to be more creative and innovative in their teaching and learning approach in order to provide effective learning outcome for each course in the programs [3].

For that reason, since 2006, the Department of Chemical and Process Engineering (JKKP), Faculty of Engineering and the Built Environment (FKAB), Universiti Kebangsaan Malaysia (UKM) has been implementing the OBE system thoroughly through varying the delivery method of teaching and learning process by introduced the project-based learning, project orientatated problem-based learning, active learning and cooperative learning [4]. Each course of teaching and learning activity is designed based on the programme outcomes (PO) and the programme educational objectives (PEO) that have been determined by faculty and departmental management. In the JKKP department, POs are defined as knowledge, abilities and skills that a chemical engineering student must acquire upon completion of their studies. Meanwhile, the PEOs refer to objectives that should be demonstrated by each graduated student in their career and professional life after graduation. Currently, JKKP programmes are designed based on 12 POs and 6 PEOs. The measurements of these elements need to be carried out in order to evaluate the effectiveness of the programmes in the department. Typically, each of the PO elements is measured at the end of the second semester of each year, while the PEOs are measured within three to five years after the students graduated. Thus, this study focus only on the POs performance since the data collection of the PEOs would have required more time for each batch of students.

Numerous methods were used to measure the POs achievement, such as through exit surveys, evaluation on integrated projects (IP), laboratory activities, poster, design presentation, etc. [5]. In this study, the data was collected by distributing survey form to the final year students during the Majlis Mesra Graduan, which is held at the end of the second semester of each academic session in order to honour all final year students who would soon be finishing their studies. It is because the feedback from students will allow the educators to understand and to gather data on the efficiency of current teaching approaches. This data and information is very important in order to improve the learning’s quality and to ensure the implemented teaching and learning approaches are appropriated and contributed to the targeted of the learning outcomes. Hitherto, a number of studies have been conducted with groups of final-year students from session 2010/2011 to 2015/2016 and the results showed some progressive development in terms of PO achievement.

Besides, in 2012, EAC has introduced the latest guideline to remodel most of the engineering program in the higher education institutions in Malaysia with addition of complex engineering elements which was revamped with renewed 12
new POs [2]. This paper reports the process of collecting the feedback from final year students as well as measuring the achievements of 12 POs for graduating students in the 2015/2016 session. The student feedback and data collection of these POs achievement is compared with the previous academic session. In addition, some improvement has been implemented in teaching and learning activities based on student’s feedback.

2. Methodology

In evaluating the effectiveness of teaching and learning methods in the Department of Chemical and Process Engineering (JKKP), two approaches have been used to measure and evaluate the program’s effectiveness on students; namely direct and indirect measurements, as shown in Fig. 1. However, this paper only focuses on the program outcome (PO) evaluation through indirect measurement. Whereas for the indirect measurements, JKKP has implemented several mechanisms to get feedback from the students such as through questionnaires. The questionnaires are two-way communication of information between students and JKKP.

Fig. 1. Direct and indirect measurements to measure and evaluate the 12 PO’s achievement.

Annually, at the end of second semester, JKKP will organize Majlis Mesra Graduan to honour the graduating final year students. This event involving all JKKP final year students and academic staffs. The event began with a briefing by the head of department on the career opportunities and professional responsibility as an engineer upon graduation. Then, it was followed by an interactive dialogue among students and faculty members about all their learning experiences during their four years in JKKP, student achievement, recommendations and feedback on the learning activities and POs in the department.

Through the Majlis Mesra Graduan, an exit survey was administered by distributing questionnaire forms regarding on the POs achievement to the students. Two questionnaires were distributed; graduate survey and questionnaires on integrated project (IP). The graduate survey was focused on the statements of their learning process that was experienced throughout their
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four years in JKKP and the achievement of 12 POs. While, the IP’s questionnaire contains statements on their experiences of four full cycles IP, feedback of IP content, the generic skills acquired through the IP and applying the engineering design software in JKKP.

Both questionnaires consisted of 12 statements concerning the POs of engineering knowledge (PO1), problem analysis (PO2), design and development of problem solving (PO3), investigation (PO4), the use of modern tools (PO5), engineers and the public (PO6), environment and sustainability (PO7), ethics (PO8), communication (PO9), individual and teamwork (PO10), lifelong learning (PO11) and project management and finance (PO12). Evaluation was based on a 5-point Likert scale. A Likert scale was used since it is balanced on the both sides of a neutral option and allows for a less biased measurement [6]. Overall, the 12 POs achievement were measured for the chemical and biochemical engineering programmes in the 2015/2016 academic session and then the results were compared with achievements in the previous session. Up to this date, there are 12 groups of graduated students who have gone through the full cycle of IP’s implementation in JKKP department. Through the Majlis Mesra Graduan, both positive and negative feedbacks were obtained and collected for further improvement in the future [7].

3. Results

A total of 56 students were graduated from the department in the 2015/2016 session; 24 students were from the chemical engineering programme and 32 from the biochemical engineering programme. It was shown that the percentage of the student participated in this survey are very encouraging, as much as 87.5% of the total number of students have completed this survey. The effectiveness and validity of this exit survey depends on the number of students who answered the survey [8]. It is because in the 2012/2013 session, only 60% of students were participated in the same distributed exit survey. However, the percentage increased up to 85% in the session 2014/2015 and 87.5% in the 2015/2016 session. This is very important as the involvement of students in this questionnaire can contribute to the improvement in teaching and learning activities in the department. The high percentage of student involvement also makes the better process of samples data input as well can assist the department in improving the effectiveness of the PO implementation as outlined by the EAC [5]. The respondent evaluates and gives the feedback on the 12 POs performance either their achievement levels are categorized as poor, fair, good, very good or excellent. The method used in this exit survey analysis considers the scale summative evaluation of the data obtained are shown in Fig. 2, which represents the percentage of average 12 POs achievement for both chemical and biochemical engineering programmes.

Overall, the percentages of all 12 POs achievement were higher than 70%. It was found, PO8 shown the highest percentage of 89%, followed by the elements of the environment and sustainability (PO7) of 87%. It is clearly shown that the structure of JKKP’s curriculum managed to increase students' understanding on the elements of the ethical culture of professional engineers in terms of social, cultural, global, environment and sustainable development at the end of their course duration. Others five POs also found to score percentage exceeding of 80%
including PO4 (investigation), PO6 (engineers and the public), PO9 (communication), PO11 (lifelong learning) and PO12 (project management and finance). Meanwhile, the POs which scored less than 80% were PO1 (engineering knowledge), PO2 (problem analysis), PO3 (design and development of problem solving), PO5 (the use of modern tools) and PO10 (individual and teamwork). However, that percentage still above 70%, hence higher attention was needed to improve these PO achievements in the future. To ensure that the results shown can be enhanced in the future, some improvement in the teaching and learning activities should be carried out.

Since the learning outcomes for PO1, PO2 and PO3 are related to the fundamental knowledge and problem solving skills, an interactive approach on the teaching and learning should be introduced, i.e. creating flip-flop classroom and communication through social media or application. Both PO6 and PO12 can be improved by providing opportunities for students to organize and involve in the out of classroom activities that can benefit to the community such as Chem-E-car competition, iLab poster presentation, etc. [9]. Overall, 12 POs achieved satisfactory results from the student respondents in both programs. Nevertheless, the improvement should be focussed on the low PO’s percentage to ensure the PO’s effectiveness can be improved in the future.

In the questionnaire form, the POs achievement also was compared to the others four statements that contained the element of the education performance in UKM, student’s career preparation, the relationship between lecturer and student and the facility/infrastructure as shown in the Fig. 3. It was shown that the element of lecturer-student’s relationship has the highest percentage; 88.4% compared to the other elements. Hence indicating that the students were very satisfied with the decent connection and interaction shown by the lecturers to students during their four years studies at the JKKP. While, the infrastructure element shown the lowest percentage; 75% as the insufficient and poor condition of classrooms and computer facilities requires appropriate improvement and upgrade.
4. The effectiveness of integrated project (IP) implementation

The Department of Chemical and Process Engineering (JKKP) is continuously committed to evaluate the effectiveness of 12 POs through the student’s achievement and performance via implementation of the integrated project (IP). Each semester, the indirect IP measurement was compared with the student’s feedback which obtained through a questionnaire at the end of particular semester. The student’s feedback obtained from the questionnaire is shown in the form of percentage of students give approval to a statement related to the PO (Fig. 4). In the IP implementation’s questionnaire, it was divided into five parts; Part A of the questionnaire was about the demographics of the respondents i.e. gender and programme, Part B was about the IP implementation, Part C was about the contents of IP, Part D was about generic skills that have been acquired through the IP and Part E was about the hand-on and use of the software application in IP such as HYSIS®, iCON®, SuperPro®.

Figure 4 shows a comparative analysis on the IP implementation by the indirect measurement from the students’ feedback in the 2nd semester of 2015/2016 session. Overall, all parts in the IP implementation questionnaire achieved the target percentage; more than 75% of the student assessment with the average percentage is 84%. Meanwhile, Part C and Part D shown the highest percentage compared to the other parts in the questionnaire. It shown that the student felt the IP has helped themselves in order to understand and strengthen the basic concepts of engineering chemistry/biochemistry, as well exposed them to the concept and practice of the sustainability such as safety and environmental protection. In addition, the IP can improve student’s communication skills in order to be the competent student, as well helps students to understand the current issues related to engineering, also analyse and interpret data, thus providing a critical view on the certain engineering issues.

Figure 5 shows POs achievement comparison on the IP implementation since 2010/2011 until 2015/2016 session. From the Fig. 5, it clearly shown a slight increase in the achievement percentage in the 2015/2016 session compared to the previous sessions even though the increment is quite low [10, 11].
probably due to the acceptance and understanding of students in the implementation of the 12 POs, which meant that complex engineering problems were emphasised on in each of the teaching and learning activities [12]. However, as the overall, the Chemical and Biochemical Engineering program has reached a target percentage about 75% through the questionnaire and student feedback.

Apart from the exit survey and IP feedback, the department also conducted other activities to gain students’ feedback, such as a student dialogue for every semester, and open-ended lab activities to obtain constructive feedback regarding the matters related to the POs that required further improvement.

5. Conclusions

The POs achievement shown by the graduating students of Department of Chemical and Process Engineering (JKKP) was good and laudable. Some improvement and attention should be made to ensure that JKKP’s graduates can acquire and use knowledge of basic science and engineering; identifying problems, formulating and solving complex engineering problems, ability working as individuals and
teamwork, work ethically and communicate well. Thus, it is responsibility of the faculty member to improve the quality of teaching and learning in the future. Regular monitoring is an important aspect in the process of continuous improvement of the education in the future.

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