Integrated Project: An Innovative Way To Reduce Students' Burden And Enhance Soft Skills And Integration Elements

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Abstract:- Outcome based education demands new challenging innovations in engineering education for students to be able to relate the theories obtained from traditional lectures with some practical applications with real world. Moreover, most students prone to see every course taught within one semester as a separate subject without having connection of each other. In order to overcome these students' weaknesses, the Department of Chemical and Process Engineering, UKM since 2006/2007 session has applied an innovative approach, known as Integrated Project. Integrated project (IP) is a group project that is designed to integrate all the departmental courses at each semester. For this project, students at each semester have to perform only one single project that caters all the requirement of the three or four courses within each semester. This approach does clearly reduce the students' burden instead of having to perform a dedicated project for each of the subjects. Additionally, the students have the opportunity to enhance their soft skills such as written and oral communication, long life learning to obtain updated data and information and also, identify current issues and team work. Since it was firstly implemented in 2006/2007, there were already three batches of students that have successfully completed the cycle of integrated project throughout their study from second year until final year. Surveys were conducted in order to get feedbacks from the students on the integrated project implementation. From the results, almost all students gave satisfactory remarks and comments on the implementation of the integrated project. They felt that this IP had assisted them a lot in completing their final design project and proposed it to be continued in future.

Key-Words: – cooperative learning, problem based learning, outcome based education, soft skills

1 Introduction

Spurring on the Outcome-Based Education (OBE) which had started in the Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia (UKM) since Semester I Session 2005/2006 (Nor et al. 2006; Crosthwaite et al. 2006), the Department of Chemical and Process Engineering (JKKP) has started implementing the Integrated Project (IP) at the departmental level for the Year II students in the following session (Abdullah et al. 2007; Takriff et al. 2007), as sequentially depicted in Figure 1. This OBE approach requires students to play an active role in the learning process and encourage each course lecturers adopting innovative delivery methods such as Project Based Learning (PBL), Project Oriented Problem Based Learning (POPBL), Active Learning (AL), Cooperative Learning (CL) and others (Yusof et al, 2005; Felder & Brent 2006). Up to Semester II Session 2010/2011, the IP implementation in JKKP has now been through three complete cycles in which there were three batches of students who have already completed their studies at the university by going through the outcome-based education. Takriff et al. (2007) and Abdullah et al. (2008) have explained in details about the implementation of IP and enhancement processes to the IP since it was implemented in Semester I Session 2006/2007. An IP is basically a group project that integrates three or four departmental courses at each semester (Figure 2). Instead of having to perform a project for each departmental course, each group of students has to complete only one project, known as Integrated Project (IP), for each semester; hence reducing their burden. In any chemical engineering degree course, it is traditionally ended up with a chemical plant design project in the final year of study. The final year plant design project is fundamentally a project that integrates all the elements covered from the beginning of the degree course. It blends the issues of designing a plant producing a chemical product by having to consider all the chemical engineering theories without neglecting the aspects of economy, society, safety and sustainable environments. Principally, the implemented IP imitates the final year design project and the only difference is the IP only integrates the theories covered in each semester. As shown in Figure 3, the introduced IP has always supported the final year design project by strengthening the skills of performing material balance (MB) and energy balance (EB) beginning in the first year IP, carried through until third year IP. Each chemical engineering student in JKKP will undergo six IPs before facing a more challenging IP which is known as the final year plant design project in her/his final year study. The IP is used as training platform for students to gradually enhance and improve their professionalism and design skills.

A questionnaire was distributed to the first batch of graduates who had faced the full cycle of IP in Semester II Session 2008/2009 to assess the effectiveness of the IP implementation. The analysis results has shown increasing confidence in students in adopting generic skills such as oral and written communication, teamwork, lifelong learning and the identification of current issues since it was introduced. Positive feedback was also sought from students and they felt IP should be continued in future because it really assisted them in completing design projects in their final year (Abdullah et al. 2009).

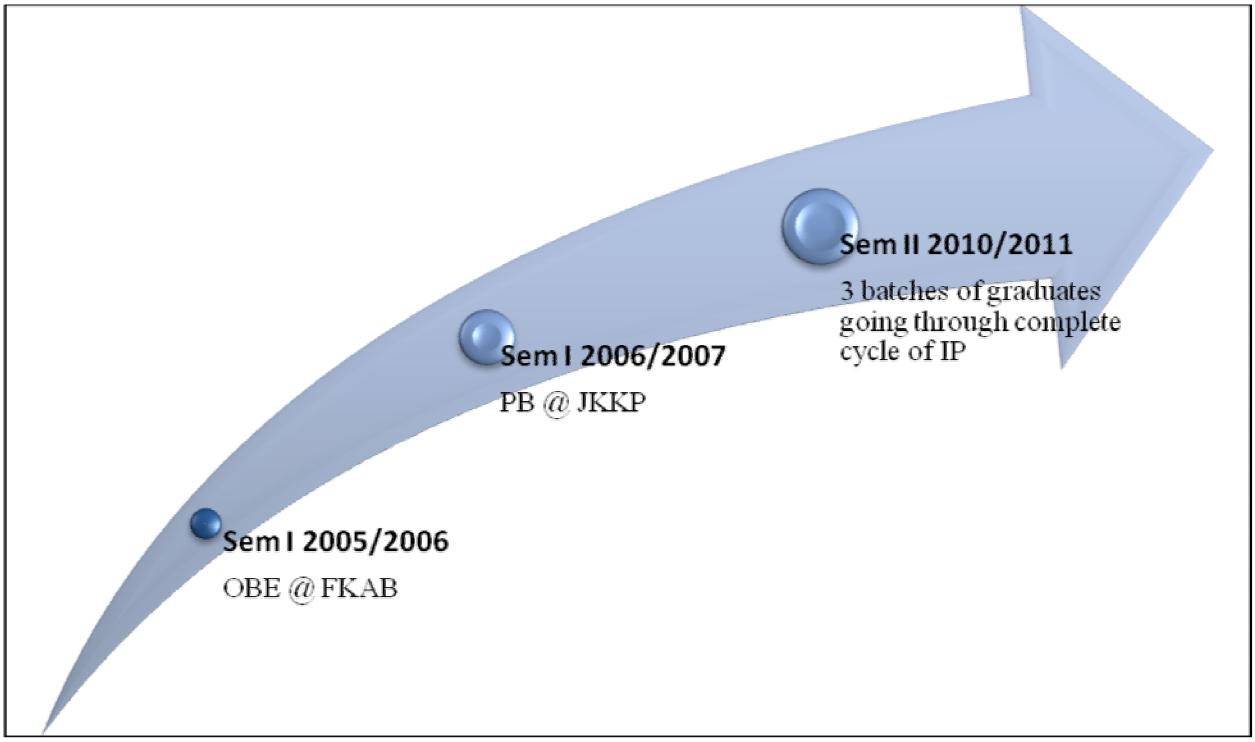

Fig. 1: History of IP implementation in the Department of Chemical and Process Engineering, UKM

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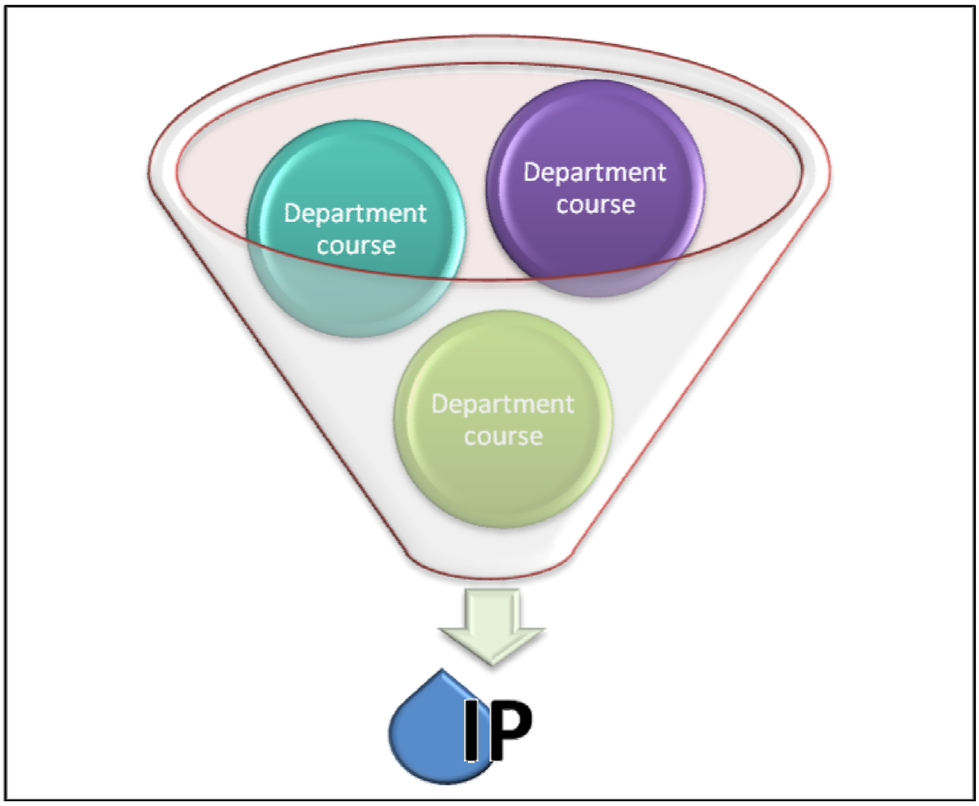

Fig. 2: An integrated project (IP) integrates three or four department courses at each semester

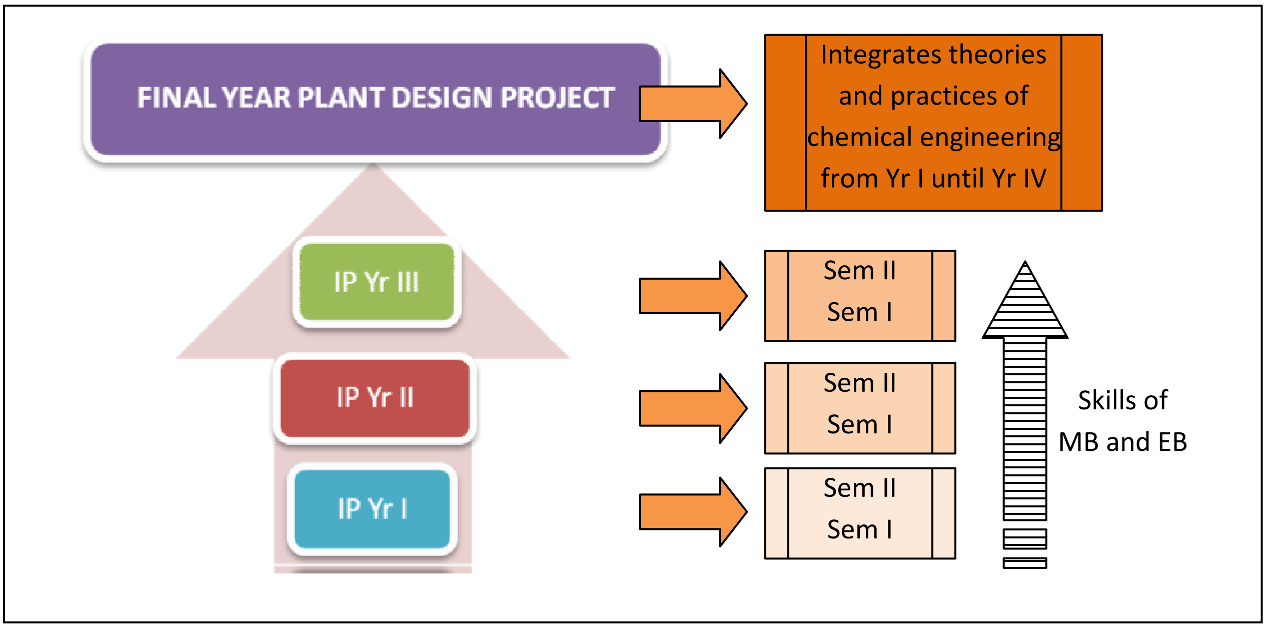

Fig 3: Implemented IP at each semester starting from Year I until Year III supports towards the implementation of final year plant design project

2 Implementation Of Integrated Project

In the implementation of outcome-based education, each course or activity must be based on the programme outcomes (PO) set by the programme. Programme outcomes are statements about things that every student should know, understand and be able to do so after the completion of a learning process (Fitzpatrick et al. 2009; Cobb et al 2007). The Department of Chemical and Process Engineering (JKKP), which offers two programmes of Chemical and Biochemical Engineering Program outlines 12 programme outcomes for the two programmes (Table 1). For the IP implementation, six POs are set to be achieved at the end of an IP implementation (Abdullah et al. 2007), namely the students should be able to:

- apply basic knowledge and theories from all the involved courses in the IP task(PO1).
- communicate effectively in oral conversation and in writing (PO2) since all groups should submit a complete technical report and present it orally.
- work in a team with the ability to manage (PO6).
- adopt lifelong learning skills (PO8) in gathering information from various reliable and good sources of journals, books and handbooks to fulfill the IP requirement.
- identify current issues (PO11) aroused along the production process of the dedicated chemical product.
- use modern engineering tools such as iCON®, HYSYS®, SUPERPRO®, AUTOCAD® and others in solving problems (PO12) and make comparison and justification with manual solutions.

As explained in the introduction part, IP is a mini design project that imitates the final year plant design project and integrates a few courses in each semester. It is a group project with students being divided into groups, each consisting 3-4 students. The IP task, centering about a production of a chemical product, has open-ended solution which can be divided into two main parts. The common task requires students to gather information on the dedicated product, how it is being produced, its marketability potential, demand and supply, any safety and environmental issues aroused along the production of the product. The other part is the specific task assigned by each course lecturer. For example, a course of Mechanical Design of Process Equipment requires each group to design a pressure vessel of absorber, reactor or distillation column existing in their plant. For another course of Cleaner Production and Pollution Control demands the student to design a wastewater treatment system for the plant effluent. Each group of students should submit a report on the IP assignment at the end of the semester and present it orally in front of all the involved lecturers. A coordinator is appointed by the department to coordinate and handle this IP.

Table 1: List of Programme Outcomes (POs) set for the Chemical and Biochemical Engineering Programme under JKKP

No.	Programme outcomes (POs)
PO1	Ability to acquire and apply knowledge of basic science and engineering fundamentals.
PO2	Ability to communicate effectively, not only with engineers but also with the community at large.
PO3	Having in-depth technical competence in chemical / biochemical engineering.
PO4	Ability to undertake problem identification, formulation and solution.
PO5	Ability to utilise a systems approach to design and evaluate operational performance.
PO6	Ability to function effectively as an individual and in a group with the capacity to be a leader or manager as well as an effective team member.
PO7	Having the understanding of the social, cultural, global and environmental responsibilities and ethics of a professional engineer and the need for sustainable development.
PO8	Recognising the need to undertake lifelong learning, and possessing/acquiring the capacity to do so.
PO9	Ability to design and conduct experiments, as well as to analyze and interpret data.
PO10	Ability to function on multi-disciplinary teams.
PO11	Having the knowledge of contemporary issues.
PO12	Ability to use the techniques, skills, and engineering tools necessary for engineering practice.

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3 Evaluation And Assessment Of Integrated Project

On the assessment of IP, there are two methods of assessing the performance of the students, direct and indirect measurement, as depicted in Figure 4. All the involved lecturers will evaluate each group based on oral presentations and written reports at the end of the semester based on PO1, PO2, PO8, PO11 and PO12. Since students are working in groups, students themselves directly assess their peers based on PO6. In addition, questionnaire is distributed to students to obtain their feedback on the IP implementation that they have undergone in each semester during an overview and comment session conducted by the IP coordinator. The questionnaire distributed to students is also based on the outlined POs. It incorporates statement towards the outlined PO achievement. Hence, this paper aims to compare analytically the assessment and evaluation done by the lecturers with the assessment made by students through a questionnaire on the implementation of IP for third year students in Semester II 2009/2010.

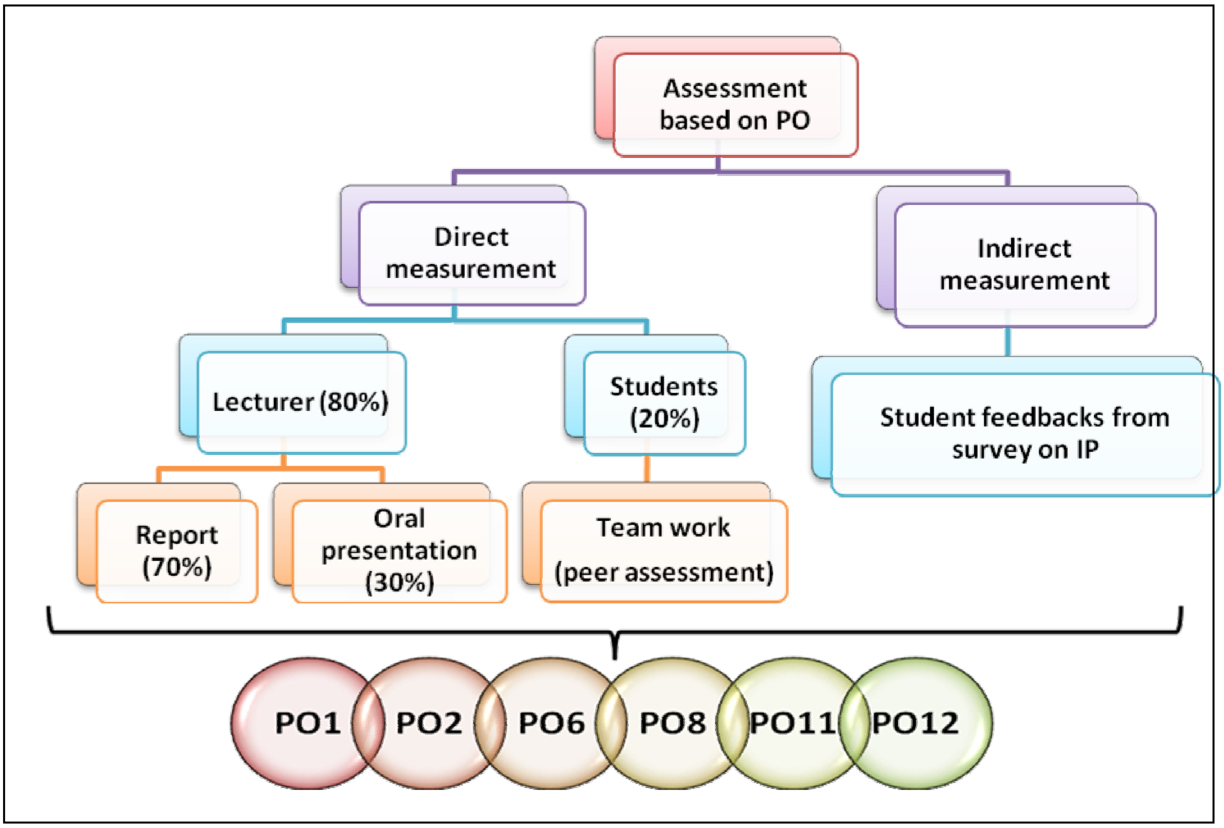

Fig. 4: Direct and direct measurement of IP based on the six dedicated programme outcomes

4 Student Performance And Effectiveness Of Integrated Project Implementation

After evaluation of lecturers and student questionnaires being analyzed separately, the section will try to compare the results obtained from both types of measurement. The comparative results are shown in Figure 5. For KK programme, no significant differences were observed for the achievement of all PO (PO1, PO2, PO8, PO11), except in PO6 and PO12. For all PO (PO1, PO2, PO8, PO11), both direct and indirect measurement reaches about 80% of the scores, indicating that the achievement of these POs through the IP is valid. As for the PO6 (team work), basically both direct and indirect measurement were done by students. The students directly measure their team member right after the IP oral presentations, in which this marks will contribute 20% of the total IP marks. A score of 80% was obtained through the questionnaires, but almost 100% scores from the direct measurement of peer assessment. The feeling of consciousness and generosity of students were more significant at the time of evaluating their colleagues since the marks will contribute 20% to the individual, resulting most of students had given their colleagues full marks for the peer assessment. Meanwhile, the distributed survey has nothing to do with the scoring, so

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feedback obtained from the questionnaire is more sincere. This explains why the marks from the indirect measurement are lower than that of the direct measurement. The same trend was also found for PO12 achievement (70% of the indirect measurement, 82% of the direct measurement) in relating to the use of engineering software in problem solving. Lecturers gave higher scores than the student assessment through questionnaires, due to different expectations. Lecturer assessment was more on the given efforts and positive attitude towards the use of modern software such as iCON ® / SUPERPRO ®, but students were always in the opinion of insufficient exposure of the software, and always expected full guidance from the lecturers on the software application.

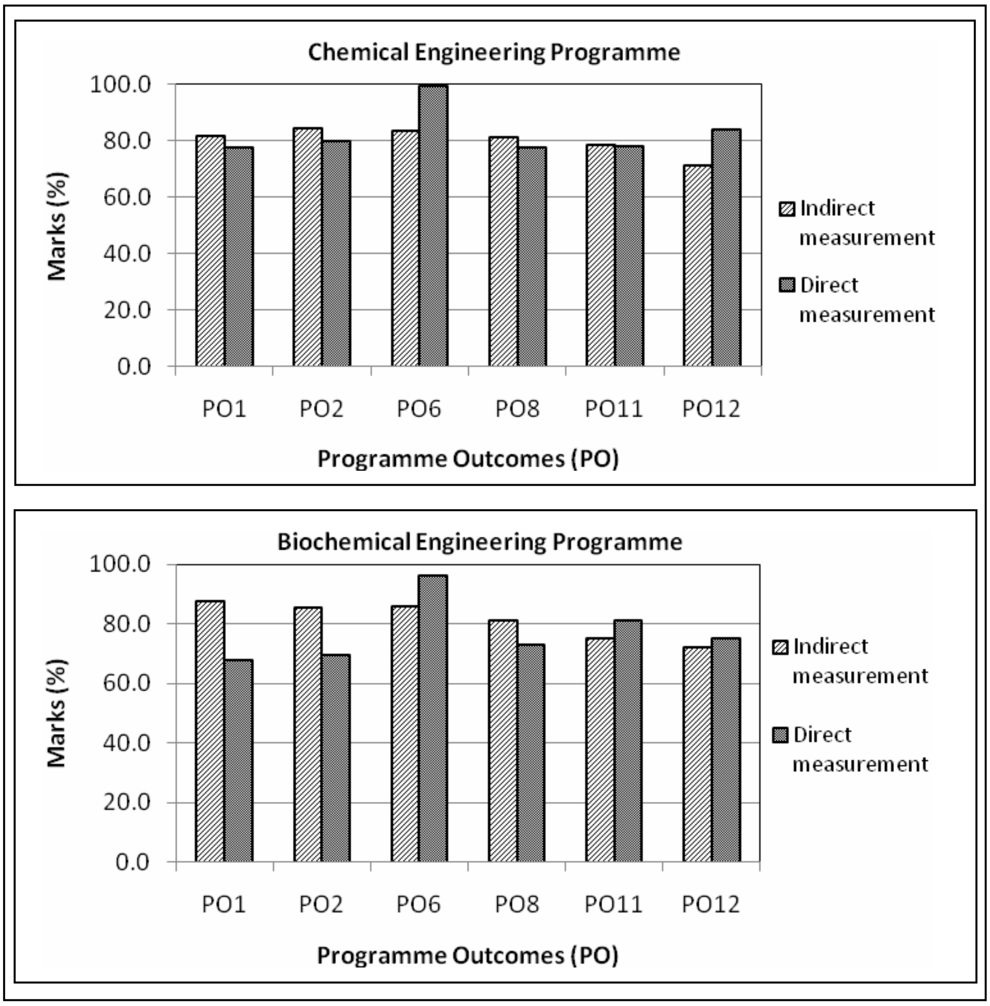

Fig. 5: Comparative results between direct and indirect measurement for both Chemical and Biochemical Engineering Programmes

For KB students, a slightly different trend is obtained. For the achievement of PO1 (application of basic knowledge) and PO2 (communication skills), assessment of students through questionnaires (90%) is higher than the assessment of lecturers (70%). For PO6, the same trend as obtained with the KK program for the same reason. As for the PO8, PO11 and PO12, there are no significant differences between direct and indirect measurement. For all three categories, the scores were between 70-80%.

On overall, for both programmes, although there are differences between the direct and indirect measurements, however the difference scores as shown in Figure 5 are not too significant. This demonstrates that the specified programme outcomes were achieved with an average percentage score between 75-85% for KK programme and 70-85% for KB programme.

5 Conclusions

The results from both direct and indirect measurement comprising marks given by the lecturers and scores obtained from students perception through questionnaire on the achievement of program outcomes (PO) via the IP implementation follows similar trend. This shows that not only students who believed that IP was very useful to their learning process, but also based on the lecturer evaluation, it indicates that students have benefited from the IP implementation. In conclusion, the IP implementation has become an innovative teaching and learning method to reduce the students' burden, has successfully integrated the courses and enhance soft skills of lifelong learning, communication and current issue identification among students.

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