Alignment of Civil Engineering Technology Graduate Attributes: Employer, Graduate and Actual Performance

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Abstract

The Programme Learning Outcomes attainment, which relate to the graduate attributes outlined in the Engineering Technology Programme Accreditation Manual, of the first batch of graduates of the Bachelors Degree of Civil Engineering Technology (Environment) programme were subjected to assessments. The assessments were triangulated with results from the graduates' personal perspective, the employers' views, and the actual performance of the graduates at the end of their 4-year study. Similar survey questions with direct reference to the learning outcomes were forwarded to graduates and employers. The responses were then correlated with that of actual performance and attainment of the graduates as recorded per course throughout the 4-year programme duration. Overall, it was found that the employers had very positive impression of the graduates, as was evident in the highest attainment levels recorded for all 9 PLOs. This is indicative of the graduates meeting the industry's expectations, at least in terms of entry level competency and skills set for further specific retooling at the respective industries. On the other hand, graduates judged their attainment rather accurately in terms of mastery of the practical skills, teamwork, lifelong learning, ethics and leadership, with close gap between their survey responses and academic records. The fact that graduates thought highly of their knowledge acquisition level (PLO1) when the actual performance was about 20% lower in this primary attribute suggests confidence and maturity entering the job market. Skills in the areas of communication, critical thinking and entrepreneurship were perceived to be not as highly polished by the graduates nonetheless, when the actual assessment showed otherwise. This alignment study provides invaluable insights to the overall effectiveness of programme delivery, in terms of curriculum and syllabus content coverage, industrial needs and programme nurturing exercise compatibility, as well as programme delivery expediency. This findings would enable a more precise and incisive diagnosis of constructive alignment within the programme architecture, i.e. well-defined relationship between the assessments, course learning outcomes and PLOs. It is also a sounding board for future students' expectations and needs, where course contents, tasks, activities and corresponding assessment methods could be refined in an objectively guided manner.

Keywords: *Programme Learning Outcomes, student's performance, employers, soft skills*

1. Introduction

The Bachelor Degree of Civil Engineering Technology (Environmental) with Honours programme is accredidated under the Sydney Accord thus designed to be compliant to Programme Outcomes as stipulated in Engineering Technology Programme Accreditation Manual 2015 [1]. In brief, the bachelor programme consist of 3 levels of learning outcomes, namely Programme Educational Outcomes (PEO) which are to be accessed 3-5 years after graduation; Programme Learning Outcomes (PLO) which are to be accessed upon graduation; and Course Learning Outcomes (CLO) which are assessed after completion for individual courses taken throughout the 4-year programme. This paper measures the PLO attainment of students enrolled in the year of 2013. This group of students are the very first batch of graduates for this programme. The PLO applied to these students, as shown in Table 1. While PLO1 - Knowledge, PLO2 - practical skills or psychomotor skills and PLO4 CTPS were hard skills attained by graduates and been utilised in a degree related work space, the other PLOs were soft skills in which the importance in graduate employability is undeniable [2, 3].

Table 1: PLOs Attainment: Tool 1 (OBESys).

PLO	Attribute or Learning Outcome
PLO1	Knowledge
PLO2	Practical Skills
PLO3	Communication Skills
PLO4	Critical Thinking, Problem Solving & Routine Design
PLO5	Teamwork Skills
PLO6	Lifelong Learning, Information Management & Professional Development
PLO7	Entreprenuership & Managerial Skills
PLO8	Ethics & Professional Values
PLO9	Leadership Skills

2. Data Collection

Tools used to measure programme learning outcomes are distict from the assesment of course lerning outcomes. The tools may be divided to perceptual and independent tools [4 & 5]. In this paper, three tools were used to assess the attainment of PLOs (Fig 1.): (1) graduates' marks from assesments directly obtained from the university's internally developed marks collection system called OBESys throughout 4 years, (2) an exit survey of the graduates' perception of their own attainment of the PLOs, and (3) a survey of the employer's perception of graduates at the end of their industrial training as shown in Figure 1. The students undergo industrial training at the end of the student's 4 years bachelor's degree programme, in other words the industrial training ends the 4 years bachelor's degree. The exit surveys were conducted on-line in the form of questionnaires. The respondents were required to make assessment based on a 5-Likert Scale perception response indicated as follows: 1 = Very Disagree; 2 = Disagree; 3 = Neither; 4 = Agree; and 5 = Very Agree. The key performance index (KPI) for each PLO is set to at least 60% of the respondents rate 'agree' and 'very agree'. The employer's questionnaires are distinguished from the industrial training assesment. For this batch of graduates, 22 graduates participated in the survey while 18 supervisors represented the employer's view.

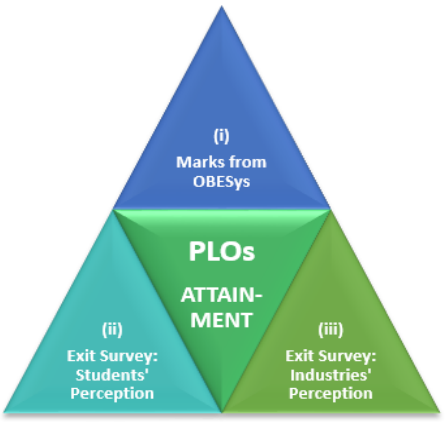

Fig. 1: 3-point measurement of the learning outcomes attainment via actual performance, graduate and employer perceptions.

3. Results Analysis and Discussions

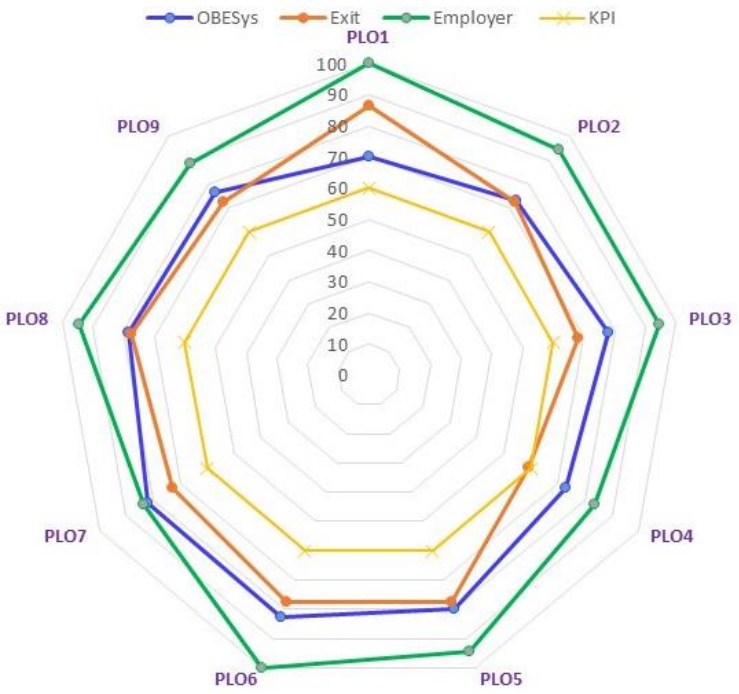

Fig. 2: PLOs attainment as per the perception of students and employers and actual assessment.

Fig. 2 depicts the PLO attainment with trianguled comparison. Overall, with the targeted attainment level for all PLOs KPI is at 60%, all outcomes were achieved according to students, industry as well as actual assessment, except for PLO4 - CTPS which students perceived themselves to marginally fall short of target, i.e. 59.09% (Fig. 3- PLO4). This slight discrepency can be attributed to several factors as follows: (1) graduates were unclear of the CTPS they were undergoing when given certain tasks, (2) graduates quate CTPS skills to experience in the field, (3) graduates were diffident on this supposedly more challenging element, and (4) the graduates judge that the program did not prepare them enough. Therefore PLO4 requires careful review in terms of tasks or activities assigned, guidance and monitoring as well as assessment.

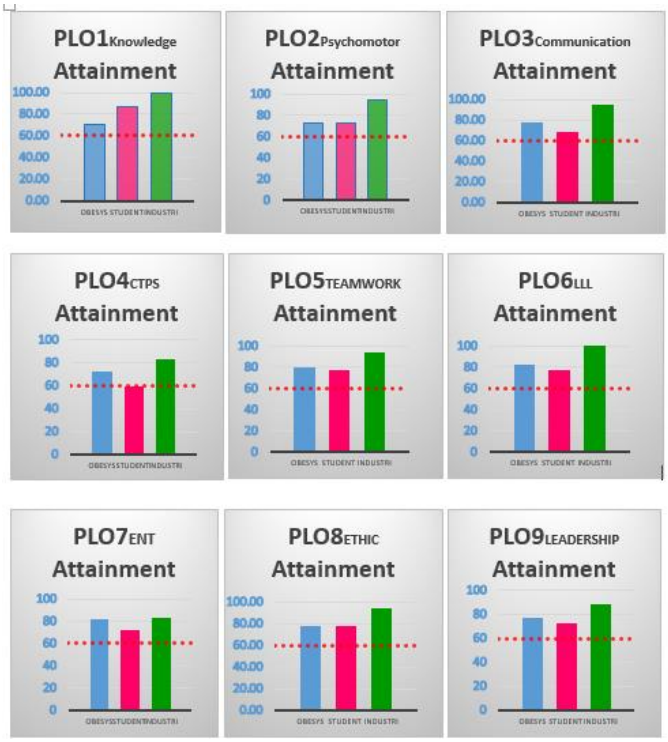

Fig.3: Individual PLO attainment by student, industry and OBESys.

It is interesting to note that the industry rated the highest attainment for all the PLOs compared to the students' self review and actual performance. Indeed, the industry reckoned the graduates were well-equipped with the fundamental knowledge to serve at the respective companies. This is evident in the 100% rating given to PLO1 (knowledge), as shown in detail in Fig. 3- PLO1. Also, as most new employees would undergo in-house training to suit the specific industrial needs, the employers apparently applauded the students' lifelong learning ability and resourcefulness with 100% rating of PLO6 (lifelong learning, information management & professional development). This suggests the graduates to be able to adapt and learn fast in their chosen organisation, an invaluable attribute for furthering their career in the challenging job market today.

Interestingly, entrepreneurial skills (PLO7) was also rated 83.33% by employers (Fig. 3- PLO7). It may be arguable that being enterprising is not critical for a new recruit, but positive traits like being earnest, diligent, commited and responsive are undeniably favoubrable among employers. Hence additional effort could be directed at enhancing the students' understanding and acquisition of these related sub-skills.

While graduates generally perceive themselves modestly incomparison to their actual performanc and of what their employeres think of them, the single component which graduates considered to have outdone themsleves was PLO1 (knowledge). This was a little surprising as students rated themselves about 23% higher than their actual achievement via the academic records, yet encouraging as they seemed self-assured of their readiness for the industry upon graduation (Fig. 3- PLO1). It is also a sign that the programme delivery could had been too successful in terms of curriculum and content provision.

Referring to Fig. 3- PLOs 2, 5 and 6, the actual performance were found to match up rather well with the students' self-rating. Practical skills (PLO2) which involved laboratory work, workshop sessions, fieldwork such as land survey, sampling etc which constitute an important part in the very much hands-on engineering technology programme. As for teamworking skills (PLO5), most tasks being assigned as group work have contributed to the particular skill development. Compatibility between the measured and self-rated attainment levels spoke positively of the programme intended outcome meeting the students' expectations and aspirations.

Nevertheless some learning outcomes were thought to be not as highly attained as the measured performance by OBESys, i.e. PLOs 3, 4 and 7. In retrospect, this resounded with the industry's perception and lowest rating for PLOs 3 & 7. Communication skills (PLO3), including written and oral forms, were rigorously embedded in every course to hone the students' ability to interface

with others, particularly in the professional context. However the skill development process was often hampered by individual temperament of the students, where for instance, excessive shyness could prevent active participation of a student in such exercises, or lack of language proficiency could hamper a student's willingness to partake in a group written report. It follows that communication skills development require more than prescribed general tasks which leave the more reserved students behind.

Referring to earlier discourse on the industry's perception of PLO4 attainment among graduates, cultivation of better skills in CTPS (PLO4) could be achieved via clearly defined critical thinking elements expected of students in their assigned tasks, e.g. identifying and framing a technical problem, formulating feasible methodology and proposing cost-effective yet environemntally sound solutions. Students need to be told explicitly the attribute to be honed in a particular task as the training of CTPS skills may be taken for granted as being readily 'done' with completion of the assigned tasks. Conscious effort on the part of the students is imperative to enhance their grasp of the skill set [6].

4. Conclusions

All in all the review exercise has directed the spotlight on some key areas of concern to be addressed in the programme, by taking into consideration views of both the graduates and industry in comparison with the students' actual performance as captured by OBESys. While overall the PLO attainment is compatible and satisfactory from the students, industry and actual performance points of view, several areas do appear to require further review and improvement. PLO4 (CPTS), for instance, seemed vaguely acquired by the graduates due to reasons elaborated earlier. Future tasks assigned with this targeted element could be more clearly defined for the students, with suitable guidelines and monitoring in the process. Interestingly, comparison between students' perception and their actual performance (OBESys) showed many of the PLOs to be rated lower than actual attainment. Triangulated, this suggests to examine the constructive alignment between the intended learning outcomes, tasks or activities assigned and assessment methods for the PLOs.

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