QUANTIFICATION ON LEARNERS CORRELATION TO OUTREACH-COMMUNITY PARTICIPATION PROBLEM-BASED-LEARNING IN ENGINEERING EDUCATION

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ABSTRACT

The correlation and effect of education strengthening strategies on students effectiveness in knowledge understanding and technology skills of environment and sustainable by incorporating community participation and outreach community field-work were evaluated in this paper. It discussed the challenges and learning approaches of project based learning (PBL)by educating students to think critically about their roles as development professionals and appreciate the role of community participation. Direct measurement of learners outcome and course grade performance of Civil engineering students from four consecutive cohorts (n=246) of Universiti Malaysia Sabah were analyzed and quantified. The correlation on course outcome of learners performance were not only important to indicate the teaching and learning effectiveness, but also to intensify the course continuous quality improvement. After four years of implementation, we observed positive influence and improvement between learners appreciation and environmental application toward community engagement, in spite of various practical challenges and institutional-stakeholders cooperation.

Keywords: Engineering education, outcome based education, community participation, Problem based learning (PBL)

1. INTRODUCTION

Educational transformation is an ongoing activity in all engineering education addressing future needs for technological capacity. In Malaysian context, engineering Programme Accreditation Manual (2012) insisted that one of the programme outcome in which engineering students are expected to know and be able to perform or attain by the time of graduation is the element of Environment and Sustainability. It is mandated that graduate engineers should understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge and need for sustainable development. Thus, the engineers will not only address the meet and need of development, but also embed the importance of the social and economic gains in the face of environmental degradation.

Aspiration of a university education has changed and reformed. The inspired reformation on engineering education to incorporate sustainable development practices requires the commitment in making the engineering education relevant to environmental protection and

community needs. Compared by Bourner (2010), traditional university education seeks to equip students with knowledge, skills and attitudes that enable them to play a part in the advancement of knowledge of an academic subject; whereas a modern university education approach shall equip the students with the knowledge, skills and attitudes to make a difference to the lives of those in the community. Nevertheless, engineers whom involved in development projects whose training is often limited to technical problem-solving approach only frequently will be neither sustainable nor successful (schenider*et al.*,2008). Therefore, community engagement is an important element in transforming engineering practice into emerged encouraging developments.

Hence for educational development strategy, Project-Based Learning (PBL) shall provide the possible reformation and development in teaching and learning. PBL provide the students with the possibility of achieving sustainable and transferable skills, while at the same time exposing them to the complexities of global and cultural issues (Kolmos, 2006, Lehmann *et al*., 2008).

In Malaysia, since 2006 the accreditation of engineering degrees by Engineering Accreditation Councill (EAC) has emphasized the academic approach of outcome-based education (OBE). The Outcome-Based Education is an approach that focuses on outcomes, i.e. the achievements of students that are measurable, proven, and can be improved. OBE is an organization of educational process that target to obtain the desired results by the students achievement evaluation (Spady, 1994) and/or work as principle that decisions about curriculum and instruction should be driven by the outcomes students that show at the end of their educational experience (John O'Neil, 1994).It requires a taught subject clearly outline the course statements of the knowledge, skills, and abilities the individual student possesses and can demonstrate upon completion of a learning experience or sequence of learning experiences which also called as learning outcome (termed in this work as course outcome). According to Harvey (2009), learning outcome is the specification of what a student should learn as the result of a period of specified and supported study.

Hence, the objective of this paper is to measure the quantitative relation between students learning outcome on the implementation of community participation–outreach approach for the civil engineering course thought at the faculty of Engineering of Universiti Malaysia Sabah (UMS).Both indicators on the report-student portfolios and overall grade are analyzed and the trends toward teaching and learning performance are discussed. Within the four years of implementation, the method and challenges in conducting the community-engagement through the PBL method were also highlighted.

2. METHODOLOGY

Consecutive cohorts of five different sample batches of civil engineering graduates were compared. Candidates were enrolled in environmental engineering course; under civil engineering program in the Faculty of Engineering, Universiti Malaysia Sabah (UMS).Environmental engineering is one of the compulsory courses for the Civil Engineering Programme students. Within these, the four case studieshas implemented PBL, whereby learners were put into small groups of 7 to 10 to allow them to communicate, work in team and

discuss within peers for the whole process of planning, implementation until completion of report and portfolio submission.

For every case, the quantification data of measurement on the effectiveness of teaching and learning in emphasizing community outreach and participation is analyzed into two indicators as simplified in Table 1.

Table 1. Indicator data performance studied in this work

INDICATOR Environmental Eng. subject Course outcome #3: community participation	MEASUREMENT PARAMETER	QUANTIFIED UNIT
Course outcome (CO3) learning indicator	Student continuous assessment and evaluation	1-Very poor, completely not achieved 2-Poor, CO is not achieved 3-satisfactory of CO achieved 4-Good, CO of the course achieved 5-Very good, course outcome has excellently achieved
Course grade (previous cohort versus PBL embedded cohort)	Total course marks of assessment and evaluation	Percentage of grade achieved (A, B, C, D and E)

The Course Outcome (CO) measurement (which in this case is CO3)are quantified based on student continuous assessment and represent as the gain ratio student obtaining >60% of the evaluation which has been described in detail at our previous publication (Gungat*et al.*, 2011).

At the end of the course, CO3 expect that learners would be able to value civil engineering problems on its effect to the environment sustainability by comprehends the impact assessments and correlate for community participation. For the next indicator, overall performance in terms of course grade were also analyzed which include the traditional (without PBL-community participation) from previous year of teaching and assessment.

PBL method for assessing the course outcome CO3is simplified in the following Fig.1 which strategized into 3 phases. The first phase of 'question driving' provided in the first week of semester. The approach of PBL shall focused on questions or problems that "drive" students to encounter (and struggle with) the central concepts and principles of a discipline. In the second phase, learners were expected to conduct constructive investigation which typically conducted within 2 to 3 weeks. At this stage, learners shall inquire, knowledge building, and resolve the question through team discussion, instructor supervision and field visit. Investigations may be problem-finding &solving, decision-making, discovery, financial and design or model-building processes which evaluated from learners participation, queries and proposal presentation. Then in the third stage which is within 4 to 10 weeks of the semester, learners shall implement or carried out the project by engaging with community organization by either from suggestion by the organization/group or via establishing volunteering networks. It is worth noting that, student learning community engagement according to Bourner (2010), can take in many forms

ranging from community volunteering where learning is distilled from the experience or as service learning with students gives time and talents to community groups and organizations and receive valuable learning. Several of the community engagement project been conducted in this course were listed in Table 2.

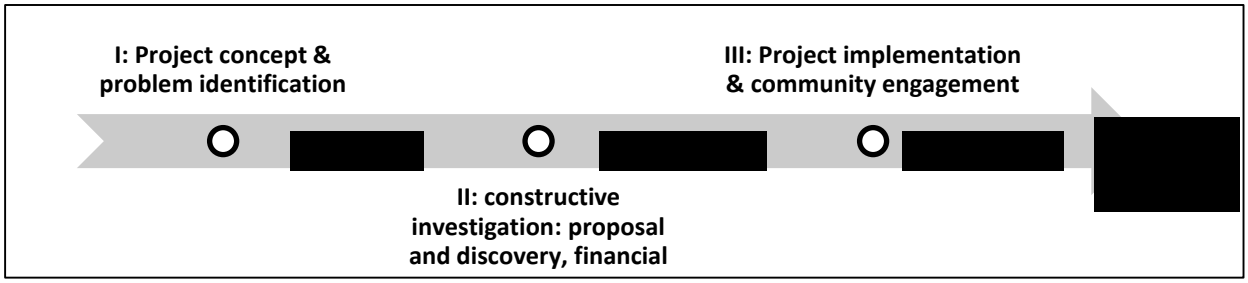

Fig. 1: Community-engagement project-based-learning (PBL) approach and time line throughout the semester

Table 2: Several of the projects conducted and the collaborating team

Community Project title	External Organizationinvolved	Community /participants	Location
Tree planting in eco-forest	Fujitsu Limited Japan and Sabah Forestry Development Authority (SAFODA)	Fujitsu employees, Japanese school children and UMS students	Kinarut Sabah
Orphanage home Outreach	Rumah Anak Yatim Tambunan	Orphanage residents and UMS students	Tambunan Sabah
Community and environmental awareness camp	Dept. of Environment Kota Kinabalu, Shell Sabah	School children of SK TanjungAru I & S.M Kota Marudu and UMS students	Kota Marudu Sabah
Clean Beach programmes	Kota Kinabalu City Hall, Shangri-La Tanjung Aru Resort	UMS students	TanjungAru Beach/ TelukLikas
Mini Library project at Taman Seri Puteri	Lembaga Pelawat Taman Seri Puteri	Resident of Taman Seri Puteri and students	Inanam Sabah
Mangrove restoration programme	Sabah Wetlands Conservation Society	UMS students	TelukLikas
Mud Ball program	SK TanjungAru 1	SK TanjungAru 1 and UMS students	TanjungAru and UMS hostel

3. RESULTS AND DISCUSSIONS

The total number of student and the distribution between male and female is illustrated in Fig.2.The gender distribution is considered consistent at the range of 37 to 65% male and 35 to 63 % female. Year 0 (stated as Yr0) is without PBL whereas Year 1 to Year 4 is the community PBL implementation. It is anticipated that the characteristic of gender may have little influence on the quantification on the learner's outcome. Furthermore, the batches are all final year civil

engineering undergraduate students and gender biasness may not an issue in conducting the project and working in team.

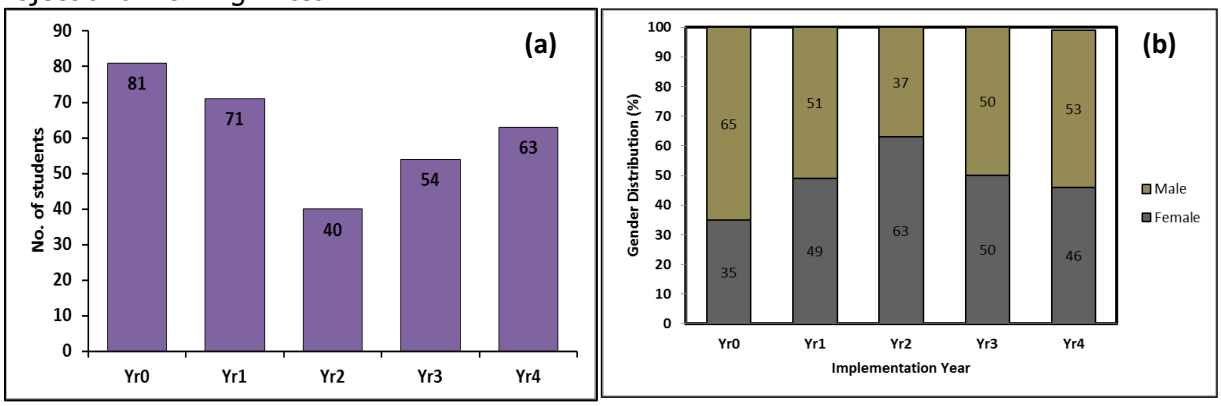

Fig. 2: Characteristic of learners sample in terms of (a)Number of student and (b)gender distribution

As shown in the data analysis of Fig. 3, the measurements of Course Outcome 3 (CO3) on the community participation and engagement project were observed to have a range above 4 indicator and was considered had achieved the learning outcome. For the assessment of course outcome of community participation and engagement, during the 1st year of implementation, 81% obtained marks >60 (out of hundred percent), but reduced significantly to 55% in the following year. During the 2nd year of implementation, the group member has been reduced (from 10 to 8 members) and this could be the main factor of a wide difference in their output. Consequently, the following year 3 has slight increase to 61% with 4.91 CO measurements, due to the increasing number of member into 9 per group. However, later at the 4th year, with reduction of group member into 5 to 7 has also reduced their achievement to 4.68 CO and only 50% obtained >60 in their assessment of reports and portfolios. The group members were influenced by the number of students in the cohort whose shall perform minimum 5 community engagement project per year, however this observation indicate that it should be best implemented with group of 9 to 12 members.

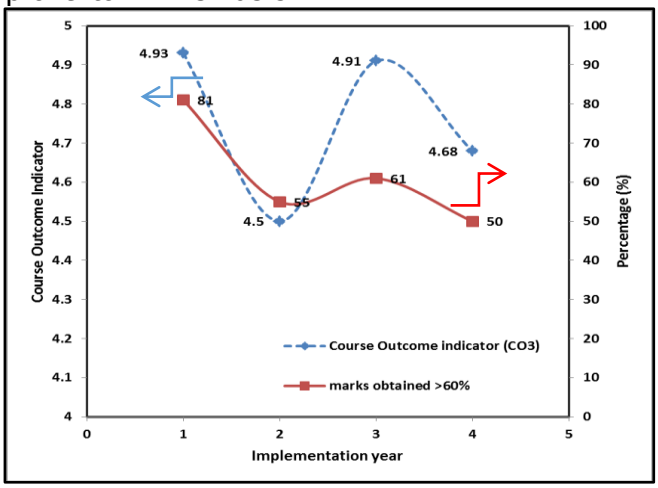

Fig. 3: Correlation on the CO3 evaluation and student performance

The next correlation was observed in the overall obtained grades as shown in Fig. 4. Previous data only highlighted the PBL assessment result whereas this data shows the overall achievement of the whole course of implementation from year-1 to year-4, with Year-0 without PBL assessment. In Fig. 4, percentage of student obtaining grade A has increased to 27% during the 1st year of implementation compared to the year-0 (22%). Increasing grade also observed for grade B and no more student getting E (compared to year-0). However, the subsequent year shows a significant drop for student obtaining A in this course. However, nearly more than half of the class obtained B when PBL is implemented and this may influenced the learners study and deep understanding because PBL adds interplay, mix and diversity to the core skills and thus creates the basis fora more integrated learning approach (Lehmann *et al.*, 2008).

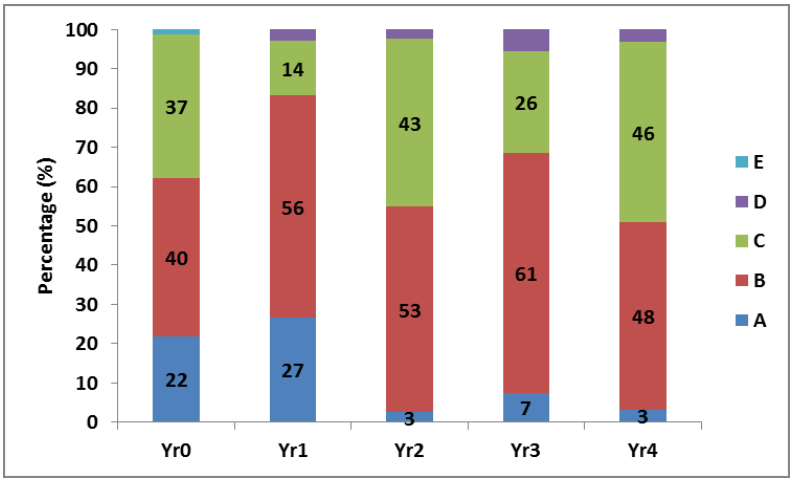

Fig. 4.Overall grade obtained by learners with and without PBL-community participation

4. CONCLUSION

The paper attempts to correlate the influence of project based learning (PBL) in community engagement in the learning outcome and overall performance of the students involved in the course of Environmental Engineering under civil engineering undergraduate programme. Two indicators were used to quantify the learner's performance. Both of the course outcome learning indicator and overall course grade performance may not directly quantified as other factors such as learners background and study style, finance and sponsor initiative, motivation and other external factors would also influence the learners productivity and creativity. However, some recommendations and lessons learnt from this activity summarized as follows:

1. Project-based learning in engaging community for civil engineering undergraduate has successfully implemented in spite of budget constraint. However with collaboration with external institution (private or NGOs) and students creativity in conducting the projects has assist and provide a win-win solution.

2. The experience on employing the Project-Based-Learning as educational strategy and method to create constructive learning environment which students are able to integrate community engagement viathe curriculum is a continuous huge task. It involves building peer networks outside of the classroom, frequent groups meetings and mentoring, field works and various managerial approaches; nevertheless, students were able to associate communities and the classroom which thus broaden the perspective of learning. As the associated task is quite high, it is observed also here that a strong group work (consist of 10 to 12 members) is required to accomplish the task within 10-14 weeks of semester study.

3. Learner's background, innovativeness and motivation in completing the task have a major influence in their performance. In spite of 'know-how', the community participation were also influenced with 'know-who', 'know-what' and 'know-why'. This concern is varied between the cohorts sample and form year to year, learners began to capture the PBL-community participation as custom approach and take short-cuts instead of going through the process from initializing until implementing the task, and thus this is reflected in their report and portfolios.

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