Implementing Sustainable Engineering Education through POPBL

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Abstract. This paper presents the implementation of sustainable engineering education to undergraduate student in Asia Pacific University of Technology and Innovation, Malaysia (APU) through Project-Oriented Problem Based Learning (POPBL). Sustainable engineering has already been the paramount term where it is no longer limited to environment, but also to the entire lifetime of the individual engineer. To inculcate every engineering individual with sustainability, education is the way to start off.

1. Introduction
Education is in an important position to lead cultural growth and transformation towards more sustainable futures. Sustainability in education aims to develop students capable of understanding the social, cultural, economic and ecological values, not only at local or national level, but also at international level. Delivery of education should have the impact of inspiring the belief that every individual is able to influence and has the responsibility to make positive change at international level and be a part of mediator in achieving sustainability. In order to do so, education should be in such a way that to focus on what students should know and capable of doing to attain better sustainability. We must have the knowledge on the needs of students to achieve it [1]-[3].

Project-Oriented Problem Based Learning (POPBL) is a new educational model to make sustainable education takes place more efficiently and effectively. The integration of project works into Problem Based Learning (PBL) proves successful in enhancing students’ interpersonal skills and abilities towards sustainability, apart from technical qualification upon graduation. Various educational institutions across the world have already implemented or in the progress of implementing POPBL [4]-[5], which the implementation means a structural change to the teaching and learning, and assessment methods.

2. Conceptualization
POPBL gains popularity due to the impact of industry on engineering education where the industry seeks highly on graduates with not only good professional qualification but also graduates with superior soft skills. This is in line with the globalization of society, commerce and culture [6]-[7], where future engineers need to equip themselves with the necessary abilities and competencies to compete and survive in the area of globalization. Implementing POPBL to achieve sustainable

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education closes the gap between skills acquired by graduates and the expectation and requirement by the industries. The implementation of POPBL in Malaysia is in accordance with the Outcome Based Education (OBE), which is a student centered learning philosophy to enhance the quality and employability of engineering graduates, adapted by country members of Washington Accord [8].

The educational institutions are constantly facing many challenges trying to achieve sustainability by implementing POPBL. Some of the most spoken about challenges are; resistance by policies, academic staff, students etc. The institution may need to change the policies regarding the teaching and learning activities in order to fully implement POPBL. There should be consensus from briefings and discussions among academic staff for the implementation and transition to be successful. The next step will be the formation of action plan, which is also a critical part in the process of the implementation, where continuous evaluation procedures has to be in action [9].

Students from multicultural background studying together can be a problem to the institution as well as the academic staff, as the diversity of students means a much different personality profile [10]-[11]. Academic staffs need to ensure that the teaching and learning activities takes place for every student. Asia Pacific University of Technology and Innovation (APU) at the moment has students from 144 countries, which translate to the difference in nationality, language, religion and educational background.

2.1. Bringing in the changes

There is a saying of “the only permanent thing in engineering education is change”, and this statement clearly shows the engineering education is highly industry driven and reflects the global social changes. Change is needed in engineering education to achieve sustainability in terms of the way it is delivered, but resistance is there for the change. The first hurdle is the top management of an institution. They have to be convinced on the advantages and the importance of sustainable education in order to make changes to the existing institution policies. Policy changes are needed due to the constraint of assessment criteria set. Besides the internal barrier, the changes have to meet with the criteria set by the accreditation body, in the case of Malaysia, is the Engineering Accreditation Council (EAC) of Board of Engineers Malaysia (BEM). The program has to be designed to meet the accreditation requirement and sustainability.

The next barrier will be the resistance from some of the academic staff. Cooperation from all academic staff is not quite possible in the beginning of the process. Generally, academic staff can be divided into four categories [reflect], which are: (1) those who want to change (the pioneers) (2) those interested, but discouraged by logistic, lack of vision, skills, resources or action plan (3) those reluctant to change (4) those against change. Those academic staffs who want to change and those interested are easier to train. Academic staffs whose reluctant or against the change are likely not participating in the training. Besides, senior academic staff may think there is no need for a change because they have done it right all the while and they have dozens of successful examples of their students who achieved and understood the concept of sustainability even without the implementation of POPBL. These groups of academic staffs might need to be pushed by the top management or the institution.

Students will possess opposing voice to the implementation of POPBL too, thinking the workload will be increased [12]. Students need to prepare before coming to the class instead of the conventional way where students come to class to listen to the lecture. Students have to be very independent in completing the project, which some of the students might dislike. Workload in term of hours needed in a particular module in significantly increased. Different students may have different perception on this new concept of sustainable engineering education. With not over assessing students in mind, POPBL has to be properly planned and implemented with care so as not to have students in disadvantage while achieving the objective of POPBL to educate the importance of sustainability for the present and future.

2.2. Multicultural
Students from different culture background seem to take a difference approach at looking at the same problem, and they tend to have different personality which likely to accept a certain teaching style better and affect the academic performance [10],[13]. Teaching the students with multicultural background with single teaching styles might suite only certain group of students, and the rest might feel uneasy with the lecturer. Zaki and Luiz [multi] shows the comparison of engineering students of Saudi and Canada [rosati] using the Myers-Briggs Type Indicator (MBTI) approach, which sorts four major types of personality, Extrovert (E) and Introvert (I), Sensing (S) and Intuition (N), Thinking (T) and Feeling (F), Judging (J) and Perceiving (P). The four major types thus give 16 possible types of personality, and suggest the preference of the individual.

Students from various countries with different culture can have very much different personality which adds to the challenge of providing students a fair teaching style for all. A lecturer would not be able to use different teaching style for each different student. Effort has to be done to inculcate the students to enhance learning in different teaching and learning environment. Team work aspect which is highly important in the implementation of POPBL will be another challenge as personality types do affect team performance [14]-[15]. Students tend to form a group together with friends from the same ethnic or culture rather than good students tend to form groups among themselves and leaving the weaker students working together [16], exactly what happens in APU. Mixing students randomly or based on equally distribution considering gender, ethnic, nationality etc often caused uneasiness to the students. Even though discussions take place among the group members, but the final outcome of a project is often the compilation of individual work rather than a piece of work from the knowledge sharing among group members.

Multicultural scenario in APU comes along with large knowledge gap among the students, which differs the situation here from elite university with diversity of students. Often good students will do most of the parts for the project and leave some part for weak students to complete. This happens as good students not trusting weak students or the weak students just want to be free riders in the team. And as consequences the concept of sustainability does not reach out to all the student has how it was planned out to be. This issue can be addressed by using self assessment and peer assessment [17]-[18]. These assessments are helpful for the lecturer as discussion and collaboration among team members happens not only in the classroom, but also outside lecture hours, where it is not possible for lecturers to be aware of the contribution of each student in their respective group and how the students managed to incorporate the importance of sustainability in their assessment. However these methods may not be reliable if the group members do not reflect the true contribution in the assessment or some might try to sabotage their friends.

3. Conclusion
Achieving sustainable education does not rely on the effort of a single individual; it is the team work and collaboration of several people from different background and levels. It requires for changes in the engineering education to create a better understanding towards achieving sustainability. APU is working on to ensure sustainable engineering education for our multicultural students through POPBL.

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