Multidisciplinary Engineering Service in Community (MESIC)

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Abstract:

1. Introduction

In era of globalization, graduate engineers are expected can challenge themselves in technology and industry niche. In Industry Revolution (IR) 4.0, this issue is highlighted. Engineer produces need well prepared from aspects of knowledge, skills, and attitudes. These three dimensions of aspects (knowledge, skills, and attitudes) known as engineering competency. ABET (2017) referred engineering competency as the ability to demonstrate the knowledge, skills, and attitudes that fix with specific tasks at the given environment. Hence, a lot of approach and practices in engineering education evolved to develop these kinds of abilities. Other than that, the 21st teaching and learning century is also explored and implemented accordingly. The objective of this paper extent to develop a design-oriented engineering service-learning program. Therefore, the engineering service project was designed, namely as Multidisciplinary Engineering Service in Community (MESIC). MESIC as an intervention based on the four values of multidisciplinary collaboration (roles and responsibilities; values and ethics; communication; team and teamwork). This paper also provides an overview of the MESIC program as well as the inclusion of the practices and student outcomes in the aspect of multidisciplinary learning nature.

2. Theoretical framework/literature review

In setting the goals for any working system, engineers are asked to design and evaluate by industry, then they will be expected to interact effectively with people of widely varying social and educational backgrounds. Past literature, using meta-analysis technique concluded that service-learning programs have a positive impact on students' attitudes, social behavior, and academic performance (Celio et al., 2011). Many engineering programs offer new and meaningful service experiences for their students. Service learning involves students in rich learning experiences in terms of knowledge, skills gained and make them responsible for their own learning process (Bielefeldt et al., 2010). From past studies, there are several service learning that succeeds is implemented. Purdue University one of the successful organizations actively implemented engineering services in national and international level. It's called the program as Engineering Project in Community Service (EPICS). Hence, this engineering service

learning (MESIC) is adapted from previous literatures to designed the best practices of service learning based on multidisciplinary learning. In this study, the theoretical framework is based on the theory of social constructivism (Vygotsky, 1978) and experiential learning (Kolb, 1984). Social constructivism maintains that human development is socially situated and knowledge is constructed through interaction with others. It also supported by learners with different skills and backgrounds should collaborate in tasks and discussions in order to arrive at a shared understanding of the truth in a specific field. In real-world practices, especially in the innovation and commercialization sector, employers view graduate skills from the perspective of organizational fit. Therefore, the scholarship of knowledge and ability to function well on multidisciplinary are known as important criteria demanded by industry towards engineering student. Besides that, multidisciplinary aspect also being investigated in this study. ABET (2017) listed out multidisciplinary teams as one of the student's outcomes. In this context of study, multidisciplinary refer to the student on the different background of engineering. All these related disciplines are presented together to solve issues in community served and shows complementarity of discipline.

3. Methods/analysis

An exploratory sequential mixed-method design is used in this study. In this research, it involves of first gathering qualitative data from the synthesis of literature reviews about engineering service-learning program. Activity book is developed as guidelines through the program. The learning outcomes in activity book is facilitated by facilitator. By using purposive sampling, undergraduate students from four faculties (Mechanical Engineering, Electrical Engineering, Civil Engineering, Chemical and Energy Engineering) at southern university in Malaysia being selected. Students were divided into five people in one group and assist by a facilitator. Using quasi experimental one group pre-posttest, the values of multidisciplinary learning is investigated. From that, data from survey questionnaire will analyze using inferential statistic. The four values of multidisciplinary collaboration were adapted from previous study (Yusof et al., 2019). The explanation of each value as below (Yusof et al., 2019):

a) Values and Ethics (VE)

To work with individuals of other engineering disciplines to maintain a climate of mutual respect and shared values during delivering of community service (deliver product to the community).

b) Roles and Responsibilities (RR)

To apply knowledge of one's own role and those of other engineering disciplines to appropriately assess and address the issue/niche/solution needs of the community service.

c) Communication (CC)

Can communicate effectively with multidisciplinary team member, the community served, partnerships, and other in a responsive and responsible manner that supports a team approach in community service (deliver product to the community served).

d) Teams and Teamwork (TT)

Apply relationships-building values and the principles of the team dynamic to perform effectively in the multidisciplinary team during community service (deliver product to the community).

4. Results and Discussion

Qualitative analysis from past literature is analyzed and the best elements of service learning and values added is examined. From the data, MESIC is designed based on four elements. There was multidisciplinary collaboration, engineering design, partnership, student centered and community served. Elements of multidisciplinary collaborations is added to design the activities involved based on How People Learn (HPL) Framework. The data collected indicates the positive results. All the students reported they had meaningful learning. The findings show that communication skill gives a higher number of reflecting students followed by team and teamwork, roles and responsibilities and ethics and value.

5. Conclusions and contributions to theory and practice

As a conclusion, this study reveals engineering service learning (MESIC) highlights a positive impact to multidisciplinary learning. The purpose of this study was to investigate the extent of undergraduates' practicing multidisciplinary learning in design-oriented engineering service learning is achieved. For future study, activity book can be improved and also has a version for facilitator.

Keywords: service-learning, engineering project, multidisciplinary

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