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LINKING PROFESSIONAL CONDUCT FOR UNDERGRADUATE ENGINEERING WITH CIVIC ENGAGEMENT THROUGH TEACHING AND LEARNING

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Abstract

Students and facilitators in an undergraduate engineering degree program at Taylor's University demonstrate how they link professional conduct to the learning in a civic engagement activity. This paper provides insight into reflection about learning and teaching that undertook in the process and how the authors improved our instructional strategies. With a conceptualized civic engagement activity on health, safety and environment aspects (HSE), a teaching and learning activity is discussed on its implementation. The service activities are undertaken with organizations in various underserved domains of community in Malaysia. Students reflect on their experience in these settings with organizational members and community. They organize their reflection to demonstrate how they link professional conduct required for HSE. Findings from student reflections analysed using thematic analysis related to a number of themes in the way students interpreted their learning of HSE with civic engagement. However, the limitations of study provide insight into developing civic engagement as a meaningful exercise for understanding HSE as a driven commitment through participation for engineering students.

Keywords: Service learning, Teaching, Engineering education, Professional, Civic engagement.

1. Introduction

Civic engagement or community service as part of a module can serve as a useful activity to ground links between engineer's roles as a professional and serving the society. Civic engagement covers a broad array of activities that are designed to identify and address issues of public concern [1]. Civic engagement activities can

range from distributing food to the homeless till working with underprivileged communities to develop a sustainable solution that will benefit them [1].

The activities mentioned are reflected in current educational curriculum as service learning activities as well. Service learning is a form of experiential education in which students address human and community needs together with structured opportunities in the curriculum to promote student learning and development [2-5]. These structures are intentionally designed and thus, as an instructional strategy has implication to teaching and learning. Civic engagement as activities could be where students engage and identify needs of society without any curriculum need identified but could be extended to some compulsory requirement [2]. These are unique strategies catered to the learning outcomes identified in an experiential form although the reciprocity to the community may not be expected [2].

Service learning is incorporated in its experiential form mainly because it has more value in terms of first hand learning experience with the underserved community compared to a theoretical form [3]. Learning from experience is an outcome of a process where reflection and reciprocity is embedded as part of the instructional strategy [3, 4, 6]. Service learning in engineering education has been undertaken in the context of design education as well as community development where students provide technical solutions to urgent problems in the community [4]. Service learning as the appropriate context for learning design in which traditional learning with technical personnel is complemented with other interactions [3]. Instructional strategy is thus improved from traditional approach with the incorporation of various values which is derived from the process of reflection and reciprocity from learners to teachers [2, 3, 7, 8].

Community projects with service learning for engineers require expertise in both technical and non-technical dimensions [3]. Thus, becomes a challenge for engineering educators in choosing the right kind of project for learning [3]. Community projects require prolonged time as well as coordination of activities to identify opportunities for engineers to answer the needs of the community [4]. It thus produces its own complexity resulting from the interaction within unlikely circumstances with relevance to engineering activities. For example, engineering student together with social work students collaborate in an international development project may be attractive but potentially be a huge challenge in terms of mobilisation of resources and eventually sustaining the project for the module. Perception of students may also be hindrance to the success of the activity as students may perceive this as social work and not part of their obligatory roles as engineering students [3].

Faculties committed to education of engineers through service learning have provided an insight on how much coordination is required for first hand service learning experience [1, 3-5]. Improvised instructional strategies incorporating lectures on link between professional practice to the service activity enables teachers and students to enact on learning from classroom level. This approach is to supplement theoretical form of service learning in which the authors allow students to engage on service activity and come back to the classroom to further reflect and respond. A response maybe in a tangible product design which provides technical solution to determined problem. A discussion to understand social and professional identity could be another response. The latter response is discussed in this paper as a

form of strategy to engage first to enact on reflection. Students may reflect using a guided assignment in which the teacher facilitates the linking of the assignment to the service activity. This activity relies heavily student teacher participation including teacher reflection. Teaching and learning is operationalized in and outside field thus exploring appropriateness of the strategy is an evolving process.

Engaging engineering students as part of community service activity is a step towards transformation in which the authors learn to connect, care and advocate. Civic engagement is a useful concept to implement in engineering curriculums worldwide as it enables students to develop and execute initiatives that benefit a deserving community. Many community based organizations have now become channels for bringing learners into context where information about the underserved community and the needs of a community is communicated in a much more constructive form. Social work is evidently where partnerships occur between many fields in terms of civic engagement and collaboration with engineering is also evident in literature. Similar contexts of learning are discussed in the following section with regards to involvement of students on service activities organized by community based organizations.

Health, safety and environment (HSE) are important aspects informing industrial and organizational practices from conventional regulatory systems to embedded cultural value systems. Informed mainly by the interest to provide safety at work, it forms one of the main basis with regards to ethics of engineering professional development. In terms of engineering education, it is indicative of a prolonged history of engineers committed for the health and safety development and in recent years includes environmental aspects informed by sustainability principles imbibed into practice. Discussing HSE as part of the engineering culture suggest engagement with a specific value system in which engineers are committed to uphold. Upholding HSE as part of one's culture opens development of understanding for the engineer on how learning is done through a socio-cultural perspective. With interest in linking social learning with a value system, HSE and its practise became the framework in which the authors understand engagement and how engagement is translated into themes which informs us deeper about the experience of learning.

The development of civic engagement in a community service activity is based on broad principles of engagement. During the activity, it is expected of the students to develop a practical sense of adaptation considering ethical and legal dimension involved to ensure effectiveness of engagement. Thus, the following section illustrates how students draw ideas with regards to engagement in practical terms in relevance to professional conduct on health, safety and environment (HSE) matters from a community activity. The detail of the context of the activities as well as how it fits with current curriculum of an institution is discussed in the following section

2. Civic Engagement Learning Activity in An Engineering Curriculum: The Case of Undergraduate Engineering at Taylor's University School of Engineering Malaysia

Accreditation of engineering degrees require for engineering curriculum to reflect development of understanding with regards to engineer's role in society and their professional ethical obligation. Malaysia is no exception to the rule, noting that all

of its universities that offer engineering degrees are accredited by the Board of Engineers Malaysia and hence recognized by the Accord (as Malaysia is a signatory). BEM specifies (through its accreditation arm - the Engineering Accreditation Council) a set of Programme Outcomes, specifically, 12 statements that an engineering graduate would need to possess at the point of graduation. This is specified in detail [4]. One such outcome in particular states as follows.

The Engineer and Society - Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.

The statement above signifies the need to develop engineers that understand the complex dynamics of current society and how such an understanding would impact the development of sustainable solutions for existing engineering challenges. One way to assist in fulfilling this outcome would be through the implementation of civic engagement activities, where students would be able to learn about societies current challenges and how this would affect their learning and future development as an engineer.

At Taylor's University's School of Engineering, Malaysia, civic engagement is introduced as part of a mandatory assessment component for a core engineering module in Year 3 of its engineering degree programmes [5]. The module entitled Professional Engineers and Society. This module discusses and studies the code of ethics and professional conduct a Professional Engineer should strive to achieve and maintain. It also provides the necessary skills to ensure that undergraduate students are aware of the various learned and regulatory bodies that are responsible for the ethics of the profession, safety and health and quality management.

In total between 2013 and 2015, students in this module spent 63 man-days performing civic engagement activities. The activities are as follows.

- Working in a soup kitchen
- Cleaning homes for the disabled
- Teaching refugee children
- Developing engineering games for children in the orphanage
- Cleaning places of worship

Figure 1 illustrates a collage of picture for the activities that are mentioned earlier.

From the student assessments, the following excerpts were noted where students present narratives in which positive learning experience is related to the instructors.

"...managed to co-operate and work peacefully with other volunteers from different backgrounds towards a common goal..."

Engineers will be more aware to social issues in the country through community service and hopefully this will inspire engineers' involvement in providing solutions for social issues thus upgrading the overall lifestyle of the nation.

...the involvement in community service activities would suffice the effort to demonstrate the role of engineers to contribute towards the welfare of the public. Such activities allow them to address the needs of the people and creating awareness of placing the importance of social obligations compared to focusing solely on profit."

Although the above suggests a positive learning experience, yet considering the complexities as well as diversity of setting where the student engagement in community takes place, an in-depth study of their learning experience based on student reflections on HSE in practice could provide a greater sense of what are the themes which are covered within these interventions. The understanding derived would inform improvement of instruction for more meaningful learning intervention on understanding HSE as part of professional development and society.



Fig. 1. A collage of pictures on student civic engagement activities in orphanages and temple.

3. Findings and Discussion Based on Analysis of Student Reflection in an Assignment with Regards to Their Conduct in a Community Service

Students submitted written assignment to answer a directive question in which they could reflect on their learning based on the raised question on HSE as part of the corporate social responsibility (CSR). Discussing HSE in relevance to ethics is also pertinent in terms developing understanding on social responsibility [9] where engineering students are familiarised with the social context and responsibility is operationalised in relevance to conduct and valuing of HSE in practice. Students are thus, were expected to reflect through discussion with us prior to the activity.

1. On their conduct,
2. The meaning of participation in the community service to accomplish the objectives, and
3. How their accomplishment could help meet the requirements for environmental, health and safe operations in this country.

Prior to writing their reflections, students also discussed in length with the module facilitators with regards to what is expected from this activity. The authors the authors were the module coordinator cum facilitator with the second author observing and mainly assessing the written work. Many questions were raised with regards to what is expected from this engagement and the perspective of the engineer involving in social work. Apart from seeking guidance from our facilitation, it was also observed that students were also interested to understand our perspective on why the authors thought this could be meaningful.

Within the instruction on expectations, our narratives included how the authors would like to see reflection of engineers as part of social activity without prior understanding on what could be the engineering challenges. The main idea related were to encourage our students to explore the activity as a volunteer and reflect on the embedded practice with relevance to HSE and how these activities inform their own idea on what the experience of working with society for engineering students.

Our students needed guidance on how they could reflect upon their experience. They were facilitated based on how their work is judged which covered a few areas which includes observing and reflecting on the practice and relating to HSE, presentation of their observation through reflection as well as academic format. These areas were intended to familiarise students to explore a learning intervention through participation and later, enable them to communicate their reflection into accepted academic format. Discussion with the students also provided opportunities for students to further clarify expectations. In explaining the authors covered mainly on reporting observations and reflecting upon them.

The written essays were analysed using a simple qualitative approach, thematic analysis to denote themes emerging from the content of their essays. Thematic analysis is a qualitative data analysis methodology which mainly is an exercise of deriving codes emerging from the interpretation of collected data. These data are coded towards saturation, where emerging codes were found repetitive as data has reached a saturation in terms of what it represents. Within this study, from 15 identified reflections of students, the work was read with 6 main codes derived which could be grouped under 2 main themes, each with its own subthemes.

Two main themes identified are, health, safety and environment (HSE) in practice and serving of the underserved community. These themes provide insight into how students relate and express a variety of understanding with regards to the practical experience that they underwent within the context. The first theme refers to the practice of HSE, what is seen on ground. The second theme refers to the service aspect and how their involvement affected their learning to value service through participation. The following is discussion of the details which substantiate the themes identified.

4. Health, Safety and Environment (HSE) in Practice

Students discuss on health, safety and environment at work or in practice as the main theme through four sub themes:

- **Addressing regulations on health and safety**

Students mainly have addressed regulations relating to health and safety practices with specific recognition of Department of Occupational Safety & Hazard (DOSH) as the governing body in Malaysia. They have identified the

Factories and Machineries Act 1967 as well as the Occupational Safety and Hazard Act 1994. Apart from safety practices, not many related to environmental aspects of practices such as human environmental damage from unsafe exposure to physical and chemical exposure in the environment. This would also involve understanding of safety at work as part of regulation that upholds safety and healthiness of human environment [10, 11]. One group of students however reflected on this and related to the noise aspect within the environment that could be a source of pollution and be harmful. Noise as pollution has both auditory and non-auditory effects on the health [12] and this could involve not only large operational sites seen as typical sources but also areas with high influx of human such as hospitals [13]. The students discussed one of such environment which is a soup kitchen in downtown of the city which invites many attendees.

‘The situation in the soup kitchen was noisy which has made it hard to work and affects the organization and safety. The level of noise within this environment could also be a form of pollution with the huge number of people within a small space’ - Student reflection on working at soup kitchen

- **Recognizing safe work systems in practice**

Many of the organization involved had embedded practices in order to guard the safety of operations mainly. Students in their observation note the importance of knowing who is accountable and the protocol in place. They specify names and how the reporting mechanism takes place in which they are to respond to and how this individual is instrumental in ensuring their safety. It involved discussion of risks in intensive disorganized human environment which is usually not represented in the classroom education as the main focus of interpreting HSE and risks are discussed in organized environment such as factories. Construction sites which involve migrant workers are examples of disorganized sites as these sites are usually prevalent with uninformed workers which increases risks resulting in lost time injury. Students also did not discuss mitigation measures such as safety during fire or first aid implementation partly could be due to lack of access to all aspects of work.

‘The environment in the soup kitchen is sometimes unruly. The authors understand the importance of reporting to Mr. X who is in charge of our safety in this potentially dangerous environment. The authors appreciate his role in ensuring safe organization of provision of food’ - Student reflection on serving at soup kitchen

From our critical reflection on this aspect highlighted the disadvantage in not partnering with the community organizers. This in turn limits the access of students into the practice and proceed more meaningfully to relate HSE in practice which is usually emerges through social interaction. Partnership would provide better access into the embedded practice [1, 14, 15] which would benefit the experiential learning [3, 16] of students in understanding social behaviour in large operations and benefits of process thinking in managing operations as well as the human in context [10, 17, 18].

- **Recognizing safety in place as part of working as an engineer to reduce risk**

Students discuss safety as an important aspect of the practice. They recognize that an engagement activity involves many people and lack of understanding on social behaviour puts them at risk while serving. They emphasize on knowing the

person in charge of risk management in order to refer to rules at ground in handling the situation in which they are engaging.

Some parts of the discussion also included on how they ensure that the team members are aware of their responsibility and tasks in order to ensure the safety of the team at practice. They were also able to use the safety principle such as think safety first in the way they relate to the preparations.

For example, students related in the way they organized their planned journey by starting the journey together which ensure a thinking about sustainability approach from the start in the participation

“The authors drove the venue together as the authors wanted to car pool. This would be an environmental approach to starting the journey in a sustainable way”- Student reflection on planning journey for serving homeless at Petaling Street

However, they lack discussion with regards to safety and its relationship to accidents and the approach in handling accidents. As much as students avoid incidences, accidents do happen and needs a mitigative measure as much as awareness on prevention [10].

5. Serving the Underserved Community

The second theme derived is about the participation and experience of valuing service:

• Understanding the NGO needs

Most of these NGO's work on volunteer schemes that are mostly involving sustenance issues for the less privileged, orphanages, refugee homes as well as on the road operations. Students treat these experiences as opportunities to gather insight on the needs towards development of an operation particularly the safe operations in a designated space. These spaces become places of learning where emotions drive the need to understand the needs of others. McKenzie [19] discusses the importance of recognizing the importance of such places which provokes emotions for the build of efficacy towards handling issues in society.

Students treated the activity as an opportunity to reflect on changes that could be brought to the operational space and how they could play a role be part of that solution. Some suggestions related to the use of greener products on site and the need for repair of the infrastructure in which maintenance of the infrastructure was a safety issue.

For example, in a visit to the refugee centre, a student relates to the appalling conditions of the refugee centre which could benefit from their social intervention

‘The authors looked around the refugee centre. The authors noticed some parts of the centre which the authors considered unsafe. The authors tried to help with a little organization to reduce any risk’. - Student reflection visiting a refugee centre

• Valuing the context as a platform for participation

The chosen contexts are varied and have a variety of aspects to consider for learning. Most of the engagements are participation to understand service in the social context. However, some students were also exposed to service in cultural setting which provides an opportunity to understand aspects of built environment with specific social role such as the temple in which the challenges for

maintenance such as humidification in specific spaces for cultural and religious purposes are different compared to infrastructure for housing purposes which do not require such arrangements.

The themes derived from the qualitative work provides insight into what the students perceive as a representative of HSE practices in context where social work is undertaken. After the experiential activity, they have a better idea of what forms the operations of social work at these vicinities. Students in general were enthusiastic to report the details although some students reflected on their position as less instrumental than others. In discussion, they highlighted that it is not only about reporting their reflection but importantly, meaningful participation.

'It is mind blowing how many people turn up to receive the distributed food. I never knew there were so many homeless people in Kuala Lumpur. However, it would be better if the authors could do more things to alleviate the condition' - Student reflection on serving homeless at Petaling Street.

This also brings question as to what is the best way to serve the NGO's based on the planned roles they could play. Within their reflection, it is not clear according to them from what role they need to reflect from but rather take a reporting stance and report their objective reflection. Each of the situation is a unique event which requires a subjective rationality as well as objectivity. In subjectivity, they can report on how they interacted with the individuals with regards to the awareness of HSE values. This can be discussed in relevance to ethics in its emergent aspect when dealing with safety. Our relation with ethics are not all well founded in a macro sense but is also built through inter relationships or in the micro sense or the more subjective [20]. Apart from daily management, HSE is a value system and many organization have taken a cultural approach towards imbining the values for more effective and ethical management of safety and risks to wellbeing [21]. Proceeding in building such perspectives could later substantiate greater understanding informing HSE in practice that is more comprehensive and integrational [22]. In view of this, content of HSE discussed also requires a more updated approach in relevance to those reflected in industry particularly with the inclusion of ergonomics which discusses deeper human behaviour, human health environment and risks at work [22-24].

Despite the general positive findings in which the authors found student to positively reciprocate about their learning, the authors found other aspects that might enlighten how the authors could be biased in the interpretation of our findings as well as in the way the authors' present instructions as facilitators. Our discussion on these aspects has brought us better understanding on the limitations our qualitative findings and thus, a need to improve our instructional strategy. The following section details our discussion on the limitations and how the authors intend to improve our strategy particularly our teaching instruction.

6. Limitations of the Qualitative Study

From our interpretation on the narratives provided, the authors found students positively reciprocate on how this learning activity benefitted them. However, their pattern of their discussions is very much like the way the authors guided them when the authors were reflecting with them on examples of previous work. The process of reflection lacks critical interpretation or subjective, contextual

which suggests why such an environment invites such a practice and what could be done to promote HSE as value as a form service and social responsibility and not only a regulatory mechanism. The authors interpret that due to an objective approach in reporting according to the expected guidance, students avoid being subjective in disclosing emotional affect as well as critique on the social practise as a participants of service event . Majority of student work did not critically analyse conditions with regards to valuing HSE in a service context and what befits good practice but rather what can be observed as fitting a checklist on HSE in practice. This in turn emphasize HSE as a regulatory, mechanism but fails to recognize engineering commitment in which the authors uphold HSE as part of our value system in any context of engagement.

Reflecting only the regulating aspect without critical discussion of what informs such regulations and not depicting the philosophy of HSE in practice is simple minded exercise. Participative intervention such as involving civic engagement is intended to raise beyond cognitive into a meaningful exercise which could build our resilience in attending to a value system the authors prescribe to [18, 25-27]. The intention of such participative intervention is to develop greater sense making or meaning in terms understanding HSE and its link to the commitment of engineers in ensuring sustainability and wellbeing [28-31]. Students participating as mere observers results in superficial participation or tokenism [32] where their participation superficial lack self-reflection [5, 7, 8]. Some students proceed beyond the boundaries of the rather objective exercise and provide self-reflection as the service act has affect upon them in the way they understand societal challenges and placing HSE within the value system of society for greater social integration [33]. This in turn suggests a more subjective approach to the intervention [21, 34]. The way of learning is judged particularly in understanding every experience as unique and students given opportunity to reflect and communicate their contextual experience and potentially new founded value system on HSE in practice.

The meaning intended for such interventions are also lost in translation especially in the complex vicinity of diverse practice which the students are in the initial of familiarising themselves with. As identified within the discussions above, with building of partnership, the roles of students could be made visible at the planning level and their preparation on the context and their ideological role on their commitment for HSE could be discussed in greater relevance to establish a critical approach to the learning. In turn, this will not only be an exercise for professional but also personal development as more subjectivity [34] could be expected due to the role playing planned within the partnership with the respective NGOs.

Thus, the authors had renewed our understanding on designing instruction for the learning activity. The current approach of an open-ended question towards identifying and relating HSE in practice fails to value HSE as a commitment engineers work towards in following for the fulfilment of sustainability and wellbeing of humankind. As our focus was on the ability for students to relate to HSE aspects, the authors could have undermined the value of other kind of learning and thus, the subjectivity of the learning process. This could also have limited reciprocity in terms understanding what kind of value could be derived by students for personal development. For many of our students, this was first-hand experience and a more subjective design of instruction could facilitate them to

participate more for themselves apart from linking the aspects of the experience to professional development alone.

In moving forward, the authors refer to the understanding provided on the power of instructional strategies in which the authors could potentially design better instruction.

- **Reciprocity of learning**

When highlighting learning outcomes, a broader outcome in which students could reflect on learning goals as presented in syllabus as well as their personal learning goals. From the study, the authors recognize how much the authors have learnt from them with regards what the civic engagement is offering them based on the situation they interacted with. Therefore, engaging students in an invitation to discuss their learning in which the authors could reciprocate how the authors have learnt from them would be beneficial to both of us in appreciating the experience of reciprocating about our learning. Currently, the authors reciprocate with our own prior experiences to emphasise significance although this approach may not connect us with the aspirations of our students. This new understanding provides avenue to reciprocate on our learning particularly what they would like us to learn about them. Thus, reciprocity for service learning could start from the classroom where the instruction is given, not in the field site alone.

- **Respect of diversity**

In this paper, our critical discussion on instruction has led us to consider appropriate instruction. With regards to our classroom, appropriate instruction is subject to diverse needs due to the multidiscipline setting from various engineering discipline enjoined within a classroom setting [35]. Within the paper, the authors did not encounter any multidisciplinary statement. The authors also recognized the potential of an instruction that promotes multidisciplinary view as most of our groups of students have retained their disciplinary association in the way they formed their group. If the authors included essential questions on parallel contribution and cooperation in ensuring safety as used in the vocabulary defining multidisciplinary participation [10], it would encourage students to prioritize understanding cooperation across roles while working in parallel. Safety in practice is educated, planned and operationalized and thus, is multidisciplinary in nature [10]

Apart from that, as Malaysia is a multicultural developing country, social identities of those the students interact with may arouse deeper question about society. From our own experiences, these discussions could lead into uncomfortable positions and overwhelming emotions. When students reflect on safety aspects, the community is strange and are made of strangers. They reflect on strangeness where they experience fear. With the incorporation of the agenda of sustainable development in our curriculum[36], if development concerns qualitative improvement, thus strangers in our community need to become our allies [1]. In a society with social disparity, reflections on our social positions as elites provide an opportunity to dialogue about being instrumental for society [16].

7. Conclusion

This paper was written to depict a qualitative study using thematic analysis performed on student's reflection with regards to an educational intervention using civic engagement. The intervention was framed with the basis of using HSE

as its framework to understand practice within the social context brought by participating in civic engagement activity. The exercise of critical reflection is beneficial prior to embarking on finding relationship between instruction and service in the field. Students positively reported findings which as reflected through two major themes which was on HSE as practice and valuing participation for HSE in such contexts. A section on limitation of study was presented in order to articulate the essential questions which the authors found useful to understand impact of instructions. The authors recognised the authors needed to consider reciprocity of learning as well as the diversity in context if the authors would like to engage students beyond the disciplinary boundaries. Within this module, the role discussed was mainly on environment, health and safety (EHS) aspects within the operational dimension of a corporate social responsibility (CSR) activity. Service learning has much more use than professional development alone.

Analysis of student work is an avenue to enrich us, the educators with details on the practical undertaking of the roles by the students as part of the community service activities they involved with in current setup of society. Despite the challenges, providing educational experience with specific focus on the engagement with the community is noted to be imperative for its transformative impact on not only professional but personal development of engineering students. Efforts from faculties are required particularly for the development of engineering skills as well as positioning the students in unfamiliar contexts with other professionals. Appropriate instructional strategy is an evolving process of critical reflection on teaching instruction and learning processes. The final discussions reveal how our reflections had paved for change in instruction to accommodate the contextual needs of our students in which the authors suggest:

- A platform to discuss on learning after the experience apart from written submission to reciprocate learning as mutual learners.
- Instruction to reflect through various lenses to connect, care and advocate for appropriate technology development.

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