Service Learning in Engineering Education

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ABSTRACT

Service learning subjects are very different from conventional engineering subjects, which combine both learning and service components. In general, service learning is of key objectives to raise students' awareness of the underprivileged in the society and to apply the learnt knowledge in real-life through community service projects. This paper presents the experience of offering a service learning subject to engineering students with the primary intention to facilitate students' learning through direct interactions with the underprivileged.

Key Words: service learning, engineering education, learning experience

1. INTRODUCTION

Service learning subjects is not simply by adopting the conventional approach, but facilitating students to learn from experience through the service component. Service components aim to allow students to apply the learnt knowledge through well planned service rendering activities. Offering service learning subjects to engineering students is even more challenging, while learning process should be shaped by individual differences (i.e. intrinsic factors including individual attitude and expectations, goals and emotions) as well as environmental factors. These extrinsic factors include: clarity of direction, reward, recognition, and the presence of social pressure and punishment (Law et al., 2009; Ngan & Law, 2015).
This paper presents the design and framework of a service learning subject (ISE3S01 Engineering for the Needy) offered to engineering students at The Hong Kong Polytechnic University, and as well the experience gained.

1.1 Service Learning for Engineering Students

Unlike the conventional engineering subjects, ISE3S01 Engineering for the Needy was specifically designed for students with engineering backgrounds, with the meaningful missions to enhance the awareness of students' empathy on the underprivileged. The service component requires students to have direct interaction with the beneficiaries. Service projects have the mission of serving the community, particularly the underprivileged, with application of the learnt knowledge in the field of Engineering (i.e. Mechanical Design, Systems Engineering, Computer programming, Logistics and Operation Management, Engineering Process, and Engineering Operations Management, etc).

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1.2 Subject Design

The ISE3S01 Engineering for the Needy has five learning objectives, (a). demonstrate an understanding of the linkage between service-learning and the engineering discipline; (b). demonstrate empathy for people in need and develop a strong sense of civic responsibility; (c). apply engineering skills and knowledge to serve people in need; (d). reflect on their roles in the community both as a professional in their chosen discipline and as a responsible citizen; and (e). develop a set of tacit skills: analytical skills, interpersonal skills, communication skills, presentation skills and problem solving skills.

To achieve the expected learning objectives, a series of teaching and learning activities are designed, apart from the service components for their experiential learning, students are also provided with lectures, seminars, themed workshops and reflection sessions.

For the service component, students devoted 40 hours of community service learning at the sites of community partner(s), in 2014/2015 and 2015/2016 batches, students were divided into two streams (Hong Kong and China) went to a special need school in Hong Kong and a secondary school in Mainland respectively. The key objective of the service component was to educate students about the specific underprivileged groups in the society and to raise their awareness of the difficulties and obstacles faced by the service recipients.

1.3 Evaluation of Student Performance and Learning

Students were formed into teams to perform specific tasks according to the service/project nature. Their participation was counted (i.e. attendance, accumulative service hours, etc), while students' performance was also supervised and assessed throughout the project process. Means of assessment include community partner feedback, peer-evaluation, and academic supervisor consultation (See Table 1).

Table 1: The evaluation framework of ISE3S01

Assessment Components	How it was carried out?	Assessment criteria:
Project Preparation and background study (35%)	Students are grouped in teams to work out the project preparation and background study for the service projects. Project plans with background study reports are required (by group).	• Identification of the project objectives • Demonstration of good understanding of the background of the project • Demonstration of good planning of the project • Identification of relevant

		knowledge applied in the project • Presentation of the project plan
Participation in the Service projects (45%)	Students are required to implement the project plan developed, in the community partners' facilities. Their performance will be assessed by instructors through regular consultation and reviews, and the feedback from the community partners.	• Execution of the project plan • Demonstration of good communication and interpersonal skills in the project; • Application of engineering theories and concepts • Team work and working attitude; • Individual performance ; • Demonstration of understanding of the needs of the underprivileged groups
Reflections (20%)	Students are required to reflect on their service project experience, through written reflection reports and class presentations.	• Discussion on the service project process • Demonstration of experiential learning from the service project (i.e. the personal experience gained) • Inspirations gained from the service project processes • Association of the knowledge application (i.e. process engineering, ergonomic product design, logistics management, operation management etc) with the real service project • Demonstration of team work and good presentation skills • Demonstration of understanding of the challenges faced by the concerned group and the role played by engineering towards meeting these challenges; • Personal insights and from the experience gained

STUDENTS' LEARNING EXPERIENCE

Students' learning throughout the service learning subject and their perceptions towards their learning experience were measured, by conducting pre- and post- surveys.

2.1 Pre- and Post-survey on Student's Perceived Gain from Service Learning

Measuring on students' learning was referring to two aspects: intellectual and civic development. In Intellectual development, application of knowledge and skills, and understanding of the linkage between service and academic learning. In civic development, aspect, self-reflection and demonstration of empathy were measured.

2.2 Learning Experience of the Subject and Project

Learning experience of students was also measured, the aspects measured were generally based on their perceptions. Key items in are listed as following (Table 2):

Value & benefit
Effort
Help & support
Interaction
Challenge
Autonomy
Overall Experience

Table 2: List of items in the learning experience survey

2.3 Data Collection

Data collection was carried out in the 2014/2015 Semester Two/Summer, among the group of students taking ISE3S01 (Engineering for the Needy). Survey invitation was sent to the 51 students taking the subject, and there were 49 valid responses received (i.e. 96% response rate).

RESULTS

3.1 Changes of students before- and after- taking service learning subject

Results from the pre- and post- learning gain surveys revealed that students had shown significant progress (Table 3), in both intellectual and civic development aspects, particularly in the civic development. The encouraging results imply that service learning subject has good effect on enhancing the awareness of students on the subject matter, especially on self-reflection and demonstration of empathy.

Learning gain from SL	**Intellectual development**				**Civic development**			
	Application of knowledge and skills		Understanding of the linkage between SL and academic learning		Self-reflection		Demonstration of empathy	
Pre (mean)	5.08		5.07		4.67		4.81	
Post (mean)	5.75		5.69		5.73		5.68	
p-value		0.001**		0.002**		0.000**		0.000**

***Signature at level 0.01; *Signature at level 0.05; NS – Not significant*

Table 3: Results of pre- and post- service learning survey

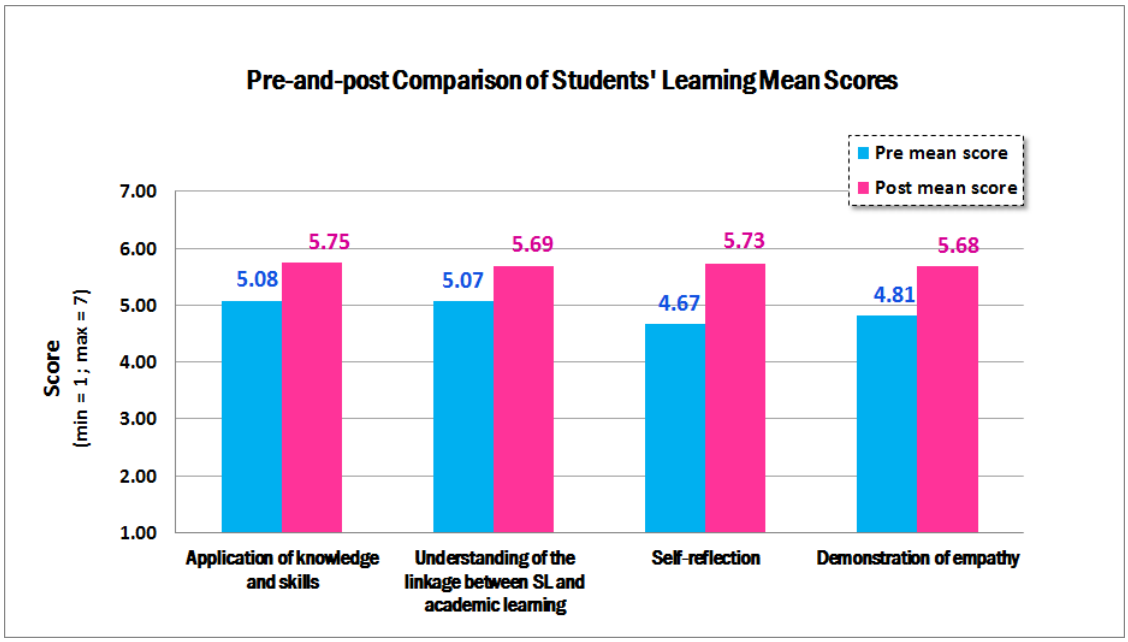

Figure 1: Pre- and Post- learning comparison

3.2 Students' Learning Experience on Service Learning

Table 4 presents the results of the learning experience perceived by students taking the service learning subject. The survey adopted a 7-point Likert scale. Results from the study show that the mean scores of most of the perceived learning experience were on the high side (i.e. 5.84-6.22).

Items		N	Mean	SD	Percentage distribution (%)		
					1-3 disagree	4 neutral	5-7 agree
Value & benefit							
3-3	I believe that the service I performed in the SL project has benefited the people I served.	49	6.04	0.978	0.0%	10.2%	89.8%
3-12	I felt that my service was appreciated by the collaborating agency/service recipients.	49	5.84	1.067	2.0%	10.2%	87.8%
Effort							
3-13	I put a lot of effort into planning, preparing and delivering the service.	48	6.19	0.982	0.0%	10.4%	89.6%
Help & support							
3-4	My instructors and TAs prepared me appropriately for performing the service.	49	5.98	1.070	0.0%	14.3%	85.7%
3-6	I could feel the enthusiasm and passion of my instructors and TAs in delivering the subject and the service.	49	6.04	0.957	0.0%	10.2%	89.8%
3-8	Help and support was usually available from the instructors/TAs/collaborative agency when I needed it.	49	6.06	0.988	2.0%	6.1%	91.8%
3-17	I benefited a lot from the interaction I had with the instructors, TAs and other students in class.	49	6.08	0.909	0.0%	6.1%	93.9%
Interaction							
3-5	My team-mates in the SL project were generally motivated and supportive.	49	5.94	1.248	4.1%	10.2%	85.7%
3-7	There were a lot of opportunities for me to meet and interact with the people I served.	49	5.86	1.021	2.0%	8.2%	89.8%
3-11	I developed a good personal relationship with my teammates.	49	5.92	1.152	4.1%	10.2%	85.7%
Challenge							
3-9	The SL project provided challenging and meaningful tasks for me to accomplish.	49	6.10	0.963	2.0%	4.1%	93.9%

3-18	The SL project challenged me to try things that I had never done before.	49	6.16	0.898	0.0%	6.1%	93.9%
Autonomy							
3-10	In my SL project, I carried out tasks that were mainly designed by me/my team rather than following instructions.	49	5.86	1.021	0.0%	12.2%	87.8%
Overall							
3-19	Overall, I found the experience of studying this SL subject highly useful and rewarding.	49	6.22	1.046	2.0%	4.1%	93.9%

Rating scale: 1=strongly disagree; 4=neutral; 7=strongly agree

Table 4: Results of the learning experience study

CONCLUSIONS

This paper presents the design and framework of a service learning subject (ISE3S01 Engineering for the Needy) offered to engineering students at The Hong Kong Polytechnic University, and as well the experience gained. Results from the surveys conducted revealed that students had shown significant progress in both intellectual and civic development aspects, particularly in the civic development. The encouraging results imply that service learning subject has good effect on enhancing the awareness of students on the subject matter, especially on self-reflection and demonstration of empathy. Though the service learning is still in the developmental stage, but the experience gained from the first time offering would definitely contribute to the further development of the subject.

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