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Service-Learning in Building Engineering by Use of Interdisciplinary Field Education

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Abstract

Previous studies have demonstrated that service-learning (SL) can help students not only develop their personal qualities but also enhance their social and civic sense of responsibility. Despite many promotions since the mid-1990s, the development of SL is popular in humanity faculties but not in technical faculties with intellectual orientations less associated with social services. The shortage of support in these areas can be attributed to the lack of a conceptual model to guide the delivery of a quality service-learning subject for disciplines like building and engineering. To fill the gap, this study examined use of a 3-tier service-learning model that offers a pragmatic pedagogical design for developing SL subjects by encompassing interdisciplinary academic education and field services. The findings reveal that, beyond the technical skills in building and engineering, students' generic skills and their awareness of social responsibilities have been enhanced through this interdisciplinary SL program.

Introduction

Service-learning (SL) has been widely promoted in higher education in recent years as a way to offer students opportunities to learn and practice civic engagement and develop their generic skills. Through offering community services to disadvantaged people, it can not only help students pursue all-around development that includes critical thinking, problem solving, and professional knowledge, but can enhance their citizenship skills and confidence and enable them to demonstrate their empathy in accord with their increased perceptions of societal problems and social justice *(Eyler, Giles, & Braxton, 1997)*. Yet higher education, especially technical departments, still tends to focus on passing knowledge to students for performing their professions with little emphasis on the civic role that students should play in society *(Suspitsyna, 2012)*. Even worse, the lack of a philosophical framework and conceptual model in supporting a pragmatic approach for addressing complex social issues is another issue for the development of SL in technical departments. In view of this, can interdisciplinary study be used to formulate a pedagogical model that

encompasses the transfer of technical skills and nurtures the students' personal qualities and sense of civic responsibility?

The education arena in Hong Kong faces the same problem. Although community service has been organized as a cocurricular activity on a voluntary basis for many years, it was not until 2010 that the Hong Kong Polytechnic University (HKPolyU) took the lead to formally make SL a mandatory credit-bearing project for meeting graduation requirements. In committing to strengthening the learning aspects of social engagement and generic development of students, the HKPolyU set up the Office of Service Learning to oversee the coordination and development of SL subjects to accomplish the mission in full gear.

As shown in Table 1, the HKPolyU has a total of two schools and six faculties that make up 27 teaching departments. Among them, a total of 41 credit-bearing SL subjects were successfully delivered in the academic year 2014–2015. Most SL subjects were offered by the Faculty of Health and Social Science and the Faculty of Humanity. Although the Faculty of Engineering and the Faculty of Construction and Environment were able to offer a number of SL subjects, many of them were interdisciplinary subjects jointly developed by different faculties and institutions from different disciplines, and the number of subjects was far behind that offered by Health and Social Science and Humanity. It is also interesting to note that eight departments and one school have not been involved in SL programs, although the undertaking has been made a graduation requirement by the university. These departments include two from the Faculty of Business, two from the Faculty of Engineering, and one from the School of Design.

Table 1. ***Service-Learning Subjects Offered by HKPolyU***

Faculty	**No. of SL subjects (No. of departments in the faculty)**
Faculty of Health and Social Science	16 (5)
Faculty of Humanity	7 (3)
Faculty of Applied Science and Textiles	3 (4)
School of Hotel and Tourism Management	3 (1)
School of Design	0 (1)
Faculty of Engineering	5 (6)
Faculty of Construction and Environment	6 (4)
Faculty of Business	1 (3)
Total	*41 SL subjects (27 departments)*

Note. Information retrieved from the Office of Service Learning, HKPolyU.

It has been found that SL subjects are popular in liberal arts colleges and in faculties of humanities but not in technical departments, perhaps because technical subjects, such as engineering and building, find it more difficult to address complex societal problems and civic engagement effectively through their specific disciplines *(Jones, LePeau, & Robbins, 2013)*. Hence, SL programs offered by technical departments tend to involve interdisciplinary studies and collaboration with local communities and social groups for field services that are usually costly and difficult to sustain. In addition, the lack of a philosophical framework and conceptual model in supporting a pragmatic approach for addressing complex social issues is another difficulty for the development of SL in technical departments. Similar difficulties encountered by the teaching staff of the HKPolyU have been voiced in experience-sharing workshops, and a number of SL subjects offered by technical departments eventually closed due to the inefficient operation of the programs. To fill the gap and facilitate the development and management of quality SL subjects in technical departments, a study has been conducted with the aim of helping technical departments develop a signature pedagogical model using interdisciplinary study by supporting the transfer of technical skills and nurturing students' personal qualities and sense of civic responsibility.

Literature Review

Higher education plays the dual role of not only providing students with the skills and capacity needed for their career development and participation in the economy, but also offering an educational experience that strengthens the well-being of society *(Kerins, 2010)*. Lucas *(2009)* stated that SL takes the form of structured experiential education to promote student learning and development through engaging in activities that address human and community needs. A study conducted by Eyler et al. *(1997)* with 1,500 students from 20 colleges and universities found that students who undertook SL combining community service and academic study showed greater improvement in their attitudes, generic skills, and understanding of social issues than those who did not. Langstraat and Bowdon *(2011)* also found that SL increases student motivation and can enhance students' intellectual and emotional development. As one of the national U.S. organizations that promotes and advances SL, the Association of American Colleges and Universities announced a distinct set of value premises higher education should provide that have formed the five core teaching objectives for SL. They are "striving for excellence, cultivating per-

sonal and academic integrity, contributing to a larger community, taking seriously the perspectives of others, and refining ethical and moral reasoning" *(Dey & Associates, 2008, p. 2)*. In addition, Lucas *(2009)* came up with the four broad essential learning outcomes of SL agreed on by colleges and universities, which include acquiring intellectual and practical skills, acquiring knowledge of human cultures and the physical world, undertaking integrative and applied learning across general and specialized education, and assuming personal and social responsibility through civic engagement. To sum up, by integrating learning and community-based services, SL has been found to help students enhance the application of their professional knowledge, pursue all-around development, nurture their empathy, and demonstrate a sense of civic responsibility as citizens.

However, translating these teaching and learning objectives into common conceptual frameworks and complementary pedagogies for education institutions to follow is not an easy task. According to a study by Mayhew *(2012)*, SL subjects are popular in liberal arts colleges and in faculties of humanities but not in departments with orientations such as building and engineering. These departments that are less associated with services related to humanistic orientations have to develop SL in an interdisciplinary form *(Wentworth & Davis, 2002)*. Schneider *(2003)* also stated that students should connect their learning with the world beyond the academy, to integrate knowledge and modes of thinking from multiple disciplines in order to create products, solve problems, and offer explanations of the world around us *(Lucas, 2009)*. Miller and Boix-Mansilla *(2004)* adopted an explanation-action approach, stating that there is a gap between teaching and application. It appears that drawing from other domains can help form solutions and interventions in defining the problem of the dynamic environment; therefore, interdisciplinary knowledge becomes the primary means that technical disciplines use to fill the gap. Apart from using interdisciplinary studies of SL, Huerta-Wong and Schoech *(2010)* stated that learning is not just a combination of input and output; it also involves the process or learning environment, which, through field education, uses both experiential learning and active learning as key factors. Peterson, Bacon, Phillips, and Machunda *(2011)* advocated an evidence-based approach and the development of pedagogical models and methods that can encourage students to adopt a lifelong learning approach that supports searching objectively and efficiently for answers to the questions posed in the study. These studies indicate that finding ways to develop innova-

tive curriculums that can prepare students to think critically while drawing on multiple diverse sources of knowledge to address societal problems is a pressing issue for higher education to address.

Experiences from different institutions provide evidence of the challenge that SL can pose. For one, the lack of sufficient resources can limit the involvement of students and the capacity to have a full complement of interdisciplinary collaboration. At one U.S. university, for example, students studied the welfare and experience of human rights in the Maya community. Faculty from multiple disciplines, including nursing, history, political science, art, and education, collaborated to form SL projects to help the local Maya community through health education and learning about the laws and customs of the United States. Although the project was popular, it lacked the resources to accommodate all interested students who wished to take part *(Kennesaw State University, 2011; Lucas, 2009)*. Lack of time can also be a challenge. At another U.S. institution, the community-based activity was packaged as a capstone project that allowed students to reflect on their learning, experiences, and personal growth in civic engagement. However, due to the substantial time required for design, implementation, and assessment tied to these courses, only a limited number of spaces were offered for student enrollment *(Mars Hill College, 2013)*. Although students showed significant gains in critical thinking, communication, problem solving, and cultural competencies, the faculty had to expend twice the effort in communication, problem solving, and cultural competencies compared to regular programs. The lack of a philosophical framework and conceptual model to streamline the programs for addressing complex social issues caused this implementation of SL to be considered inefficient. Similar difficulty is also encountered by the HKPolyU. Resources are made available, but no pragmatic signature pedagogical model is guiding technical departments on the development and management of SL projects. As stated by Jones et al. *(2013)*, if higher education is serious about preparing students to be civically engaged citizens, leaders of higher education must find ways to overcome the hurdles for nurturing the empathic concerns of the students and their sense of civic responsibility.

Methodology

Much discourse has been devoted to the conceptual modeling and pedagogical design of SL. Bringle and Hatcher *(1996)* stated that developing SL has been characterized as a cycle that includes awareness, planning, prototype, support, expansion, and evaluation. In addition, creating measurable and attainable learning outcomes

can strengthen the integration of civic engagement and application of professional skills and knowledge. Establishing desired learning outcomes will also guide the development of appropriate learning activities and provide the basis for conducting formative and summative assessment of the subjects *(Thomas, O'Connor, & Netting, 2011)*. Apart from the different methods proposed by researchers in the pedagogical design of SL, Kronick, Cunningham, and Gourley *(2011)* advocated the "thinking-skill level," which follows the hierarchical learning of Bloom's taxonomy theory (*Bloom 1994, p. 7)*. The learning hierarchy focuses on how learners apply what they know in solving problems of various levels arising from their experience in the environment. Basic learning includes acquisition of knowledge and is followed by comprehension and application. Once the tasks become complex, new knowledge and answers to meet the challenges can be generated only by going through higher levels of learning to perform analysis, synthesis, and evaluation.

In addition, Bogo and Vayda *(1998)* advocated that practice generates effective learning through two interlinked processes. One is students' subjective reflection on their understanding of and reactions to the practice situation. The second process involves conceptualization of the practice situation through making connections to theory. Synthesizing the teaching methods proposed by the aforesaid researchers and the hierarchical learning taxonomy has yielded a three-tier service-learning model that can help students apply interdisciplinary theories to conceptualize the practice situation with the aim not only of acquiring technical knowledge but also fostering their empathy and sense of civic responsibility.

Figure 1 shows both the conceptual framework and the management process of composing an interdisciplinary pedagogical SL subject. Tier 1 begins with a comprehensive review of the study area and the objectives to achieve. It forms the basis for working out the pedagogical design for a SL project that can achieve the transfer of technical knowledge and address social issues by use of interdisciplinary teaching through collaboration between academic and community organizations. Once the pedagogical design is formed and the integrated project is developed, in Tier 2, students will be assigned to perform services in the community not only for exposure and experience but also to collect the necessary data for meeting project objectives through the technical professions. Evaluation will be conducted in Tier 3 to study the impacts on the development of personal qualities and sense of civic responsibility of the students. They will reflect on their experiences in the community, synthesize the information collected, evaluate the

situations encountered, and contextualize their civic responses in both pre- and post-program evaluations and reflective journals. The three-tier service-learning model is different from most SL initiatives in that students participate in a highly structured integrated project involving collaboration between the academic institution and community organizations. To evaluate the effectiveness of the model, a project-based credit-bearing subject studying the contemporary issue of the health and safety conditions of subdivided housing in Hong Kong has been developed in the form of an interdisciplinary SL capstone project by the Department of Building and Real Estate. Approval from IRB was exempted for this research because the interviews for data collection in this study were conducted as part of the regular subject approved by the HKPolyU–Housing for the Community.

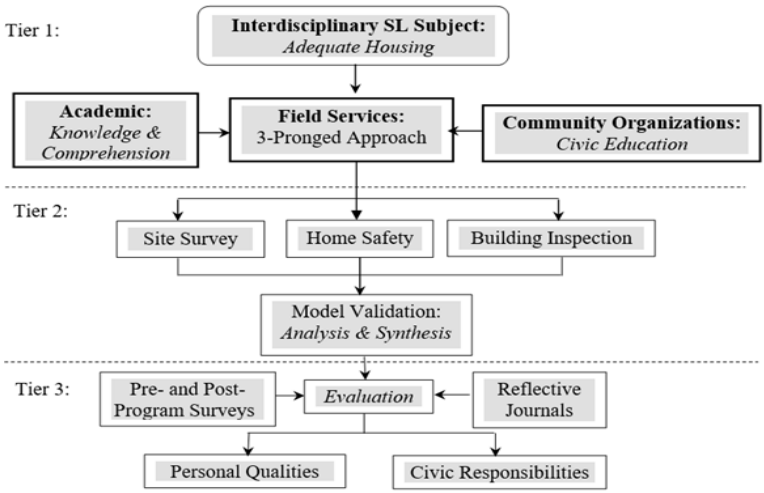

Figure 1. Three-tier service-learning (SL) model.

The Three-Tier Service-Learning Capstone Project

Hong Kong is a well-developed city that contains not only modern but also neglected districts filled with old and dilapidated buildings. These buildings are often targets of rehabilitation and redevelopment. However, the underprivileged communities, such as the elderly, singles, immigrants, the less educated, and the poor, who live in neglected housing, are often the most vulnerable when they have to face poor living conditions and possible eviction, especially in districts with urban decay. In collaboration with

the relevant community service groups and institutions, including the Urban Renewal Authority, the Housing Society, the Society for Community Organization, and Engineers Without Borders, a capstone SL project, Housing for the Community, was developed for students to address the housing problems that underprivileged community members face and to assess whether housing standards prescribed by UN-Habitat have been met (Table 2). If required, small repairs were also performed, such as installation of handles for the elderly, replacement of leaking water taps, and repair of small furniture, for promotion of a healthy and safe living environment.

Table 2. ***Adequate Housing Standards Prescribed by UN-Habitat***

Adequate housing	UN-Habitat categorization
Affordability and security of tenure	(1) Security of tenure (2) Affordability (3) Accessibility
Habitability of housing unit	(4) Habitability
Building condition	(5) Materials (6) Facilities
Community services and facilities	(7) Availability of services (8) Infrastructure (9) Location (10) Cultural adequacy

Note. Information retrieved from "The Right to Adequate Housing" by UN-Habitat, 2009.

The project was expected to help students not only broaden their knowledge in regard to technical building skills, but also develop their sense of social responsibility. In Tier 1 of the project, by use of lectures, seminars, and workshops, students were equipped with the *knowledge* and able to *comprehend* what they learned through hands-on training. Lectures were delivered by instructors to provide students with the building knowledge and skills relevant to their profession. Seminars were also given by practitioners in the industry and social groups, including the Society for Community Organization, to share their views about the living conditions of the most vulnerable groups in the society and the difficulties and social issues they face. Collaborative workshops were organized with community organizations to give students hands-on training in topics that included small household repairs before home visits were conducted. The workshops were of significance because the instructors and practitioners used role

playing and perspective taking to coach students in the importance of self-control and emotional regulation when dealing with people who might come from a difficult background. Technical workshops for performing building inspections were also given by Engineers Without Borders, the Urban Renewal Authority, and the Housing Society, and students were instructed regarding the assistance schemes available for helping these residents and for improvement of the living environment.

Upon completion of the training in Tier 1, students were assigned to conduct field services in Tier 2, guided by the three-pronged approach shown in Figure 1. Home visits were conducted to examine disadvantaged households' satisfaction with housing, and small repairs that would improve living conditions in these households were carried out. Information in regard to the health and safety of the buildings and the utility and recreational facilities of the community were collected by building inspection and site survey. Students were required to plan the activities involved in performing these community services under the guidance of the supervision team. These activities included preparing for the site investigation, assembling a building inspection checklist, administering an interview questionnaire for the home visits, and subsequently consolidating and analyzing the information collected. The supervision team arranged consultations and periodic reviews in which students reported their progress with the community services and the difficulties encountered before further progression. Based on the problems encountered by the community members and their housing needs identified from the surveys, students acting as service advisors would then search for the assistance schemes available to meet the specific needs of the households.

For the project outcomes in Tier 3, both pre- and post-program evaluations were conducted with students by use of questionnaires and reflective journals. Reflective journals were used to evaluate not only the living conditions that the service recipients encountered, but also the role that the students played as responsible citizens. A questionnaire was used to assess the efficacy of the pedagogical design of the integrated project, the improvement of the students' generic skills, and the demonstration of social responsibility. A 5-point Likert scale was used in the rating, with 5 representing the most importance and 1 representing the least. Open recruitments were offered to full-time students from the Faculty of Construction and Environment in their second year of study, and a total of 76 students were recruited in three cohorts to join the study from June 2012 to January 2015. A total of 68 disadvan-

taged households were interviewed, either by cold calls or referrals by community organizations. Community members lived in subdivided units (SDUs), partitioned rooms, or bedspace. Table 3 contains summary statistics of these households, including their demographic characteristics.

Table 3. ***Descriptive Statistics of the Interviewed Households***

	M	*Mdn*	Min	Max
Internal Floor Area (m^2)	7.4	6.0	2.1	30.0
Age	31	30	1	75
Family Size	2	2	1	4
Rent (HK$)	2903	2900	1300	6200
Household income (HK$)	8043	8000	3000	14000
Rent-to-income ratio (%)	38	37	25	62
Applied social housing	Yes		No	
	41 (60%)		27 (40%)	
No. of households	68			
No. of members	156			

Note. Statistics are per household except Internal Floor Area and Age, which are per household member.

Discussion of the Findings

Reflective journals were prepared, and both pre- and post-program surveys using the same set of questions were conducted with the 76 students to study the effectiveness of the subject. The findings are discussed below.

Efficacy of Pedagogical Design

The pedagogical design of the teaching, which included the use of lectures, workshops, and seminars, was found effective in equipping students with the necessary skills and knowledge before conducting the fieldwork. Some hands-on practice in performing small household repairs was also conducted. The students found the technical workshops particularly useful for carrying out the site survey, building inspection, and home visits. The reflective journals revealed that although the districts under study were affected by urban decay, the public facilities and community services (including the provision of education, medical, and recreational facilities) were found adequate. However, in regard to the building and home visits, most interviewed households lived in subdivided units in dilapidated buildings. They faced not only substandard housing with poor health and safety conditions, but also insuffi-

cient space and problems with tenure security and affordability. For example, a family of three might be jammed into an area of only 100 square feet. Concrete spalling, water seepage, debonding of plaster, and electrical short circuits were common due to unauthorized alterations. Although these units possessed such facilities as independent kitchens and washrooms specified by UN-Habitat, they could hardly meet the health and safety requirements.

Upon identifying households' unique problems and with help from the NGOs, students were able to search for assistance schemes. Possible solutions included the Integrated Building Maintenance Assistance Scheme offered by the Housing Society, Public Housing Schemes offered by the Housing Authority, and Subsidy for Building Improvement offered by the Community Care Fund. In addition to advice, students carried out some small repairs such as installation of handles for elderly residents and replacement of folding doors for the cooking and washing cubicles for some households as required. Through these exercises, students found that they could play a bigger role in fulfilling their social responsibility. In their reports, students indicated that they could "show more care and support to the disadvantaged groups, give suggestion for improvement"; further, they had learned "not to abuse social resources and leave them to those more in need, and help to voice out the needs of the disadvantaged group to the government and the society."

Table 4. ***Students' Rating of the Efficacy of the Pedagogical Design***

	Efficacy of Pedagogical Design	Rating
C1	Become more involved in the community	4.32
C2	Will continue to be involved in the community service	4.46
C3	My work benefited to the community	4.47
C4	Be more aware of the community's needs	4.51
C5	Have the social responsibility to serve the community	4.66
C6	Can make a difference in the community	4.12
C7	Can apply the knowledge learned to the project	4.17
C8	Satifisfied with the SL subject/project	4.21

The effectiveness of the pedagogical design is reflected in the findings of the postprogram survey shown in Table 4. The findings revealed that students treasured the learning experience of the subject with a high average score of 4.21. They were able to apply their professional knowledge and skills in the services (4.17) and

were more aware of the needs in the community (4.51) and their social responsibility (4.66) after the project. The following quote from one student's reflection is representative of the general views of most students in this subject:

> Getting myself enrolled in this course has broadened me with new perspectives when looking at housing problems, which include the lack of facilities, social welfare and services, poor building structure and others. These problems cannot be alleviated unless different parties bear their own responsibilities.… By getting ourselves to home-visit the disadvantaged households, it made me more aware and understand the real needs of these families. We have always been sitting in classroom, getting lectured and studying issues that others have raised, so what is better than getting into a real situation, knowing what people need, and finding out the problems and solutions by ourselves?

Comments on the overall arrangement of the program and suggestions on the areas for improvement were also collected. In regard to the arrangement of the program, students found the course very stimulating. The lectures and workshops were very useful in terms of offering knowledge, techniques, and insights for critical thinking on contemporary issues. The activities arranged provided an all-around development for students, and each activity effectively enabled the learning outcome. Interviews and site visits could reflect the real situation faced by those in need and provide a lot of experiential learning.

Generic Skills of Students

In regard to generic skills, students showed significant improvement in performing teamwork, as shown in Table 5. They were more eager to try their best toward meeting team goals (T1), more willing to consider criticisms or opinions from the perspectives of team members (T3), and better able to develop creative solutions that satisfied both sides during conflicts (T5). The improvement was particularly obvious in sharing of information, with an 11.6% increase in the rating (T2), and in listening accurately to team members' ideas before making judgments (T4; an increase of 8.5% in the rating). Students' good team effort was demonstrated in the excellent presentations and the well-prepared reflective journals.

Table 5. ***Pre- and Post- Program Evaluation of Teamwork***

	Teamwork	Pre-Prog	Post-Prog	% change
T1	Will do my best toward meeting team goals	4.29	4.43	3.26
T2	Share latest and relevant information with team members	3.88	4.33	11.60
T3	Try to consider criticisms and opinions of team members	3.91	3.99	2.05
T4	Listen accurately to team members' ideas before making judgment	4.00	4.34	8.50
T5	Develop creative solutions which satisfy both sides during conflicts	3.91	4.25	8.70

Referring to interpersonal effectiveness (Table 6), after the service experience students considered it easier to have a sincere conversation and sharing with others (I3) and found themselves more comfortable with people from different backgrounds (I6). However, students still found it difficult to say "no," especially to disadvantaged community members who needed both support and care (I4). Furthermore, the skill relating to awareness of doing or saying the right things in different social settings was yet to improve (I5). Students had been reminded to avoid sensitive wordings when conducting interviews with the elderly and residents whose pride and dignity had to be well-regarded. However, remarks such as "don't you have money to go traveling?" sometimes inadvertently slipped out even though the student regretted saying that. This part of the experience made students aware of the need for further improvement in their interpersonal skills.

Table 6. ***Pre- and Post- Program Evaluation of Interpersonal Skills***

	Interpersonal Skills	Pre-Prog	Post-Prog	% change
I1	Able to suggest interesting activities to do with new friends	3.84	4.12	7.29
I2	Aware of social issues in the community	3.84	4.05	5.47
I3	Can have a sincere conversation/sharing with others	3.96	4.40	11.11
I4	Able to say "no" to turn down an unreasonable request	3.86	3.71	-3.89
I5	Aware of whether doing/saying the right things in different social settings	4.13	4.04	-2.18
I6	Feel comfortable being with people from different backgrounds	4.22	4.26	0.95

The surveys also revealed students' improvement in problem solving (Table 7), particularly the ability to rank problems (P1), list all possible solutions (P2), and revise the plan when facing unexpected difficulties (P4), rating increases of 9.26%, 12.4%, and 5.71%, respectively. In regard to their ability in determining actions to take by comparing different possible solutions, ratings were not as high as before, with a slight decrease of -0.72%. Through the exercise, students found that they were still "green" and realized that they had yet to accumulate enough experience and knowledge to handle complex social issues.

Table 7. ***Pre- and Post- Program Evaluation of Problem Solving***

	Problem Solving	Pre-Prog	Post-Prog	% change
P1	Rank the problems by their degree of urgency and importance	3.78	4.13	9.26
P2	List all the solutions of the problem	3.63	4.08	12.40
P3	Determine actions by comparing different possible solutions	4.18	4.15	-0.72
P4	Revise the plan when facing unexpected difficulties	4.03	4.26	5.71

In regard to social and civic responsibilities (Table 8), students were more concerned about the well-being of people in the community upon completion of the project (S2). They were more willing to help others even if they didn't get paid for it (S3 and S4). However, it is interesting to find that the rating in regard to making contributions to meeting the needs of the community went down slightly, from 4.13 to 4.11 (S5). The reflective journals revealed that some students felt frustrated when they saw the substandard housing that the underprivileged households faced but could do little to help except show concern. In the words of one student,

> In our case study, the households clearly reflected that living in a small cubic is not the type of living that they want, but they have no choice.… Being students, we have no power and no money.… Although we cannot give them tangible help, we would like to fulfill our roles. We believe that each tiny contribution from everyone can form big power to change the society in the long run. As a member of this society, we should act rather than just sitting in the classroom, go and seek for changes.

Table 8. ***Pre- and Post- Program Evaluation on Social and Civic Responsibilities***

	Social and Civic Responsibilities	Pre-Prog	Post-Prog	% change
S1	Can define the key issues of the problems	4.01	4.09	2.00
S2	Concern about the well-being of the people and the community	3.88	4.18	7.73
S3	Be enthusiastic in serving the needy people	4.12	4.33	5.10
S4	Help others even if I don't get paid for it	4.20	4.37	4.05
S5	Make contributions to meeting the needs of the community	4.13	4.11	-0.48

Lessons Learned from the Initiative

The interdisciplinary SL subject, Housing for the Community, was well received by the students. It helped students enhance their awareness of their civic responsibility and demonstrate their empathy apart from applying their professional knowledge through interdisciplinary studies and field services.

The adequacy of housing for underprivileged households in Hong Kong has been studied through the capstone project, and the findings have been disseminated. With the benefit of hindsight, the success of this SL program is attributed to the three-tier service-learning model, yet we offer the following suggestions for improvement:

- An effective program must be able to articulate clear learning and service goals for every participant involved. In this project, the complexity of problems that households encountered in real situations sometimes left students frustrated because there was little that they could do to help. However, students could still demonstrate their empathy and showed their concern to the underprivileged group by visiting them and understanding their difficulties and showing them that they were being cared about and not alone. Households would appreciate even small repairs or offers of assistance very much.
- To ensure the effectiveness of the program, students must be provided all-around training that can fully equip them with the necessary skills not only for doing the technical work and handling household interviews but also for encountering unexpected circumstances that involve human interaction, perspective taking, and emotional control.

- Commitment of the NGOs and collaborating units in the program is of utmost importance. Although the program is considered meaningful, NGOs and collaborating units offered support indispensable to the success of the subject by providing our students with background information and circumstances faced by the households, training in the workshops, coordination for the home visits, and guidance in conducting the surveys and searching for available supporting schemes. Early involvement of the collaborating parties in agreeing on a common target for all stakeholders of the program is also indispensable.

Conclusion

Substantial numbers of studies have been conducted to explore the functions and pedagogical design of SL, which can help students develop their sense of civic responsibility and achieve all-around development. However, many of these studies are confined to liberal and humanities fields rather than technical subjects, which are less associated with social services. Very often, the hurdle is the lack of a conceptual framework and a signature pedagogical design to follow. To fill the gap, this study has proposed the three-tier service-learning model for the development of SL subjects, in particular for technical subjects such as building and engineering, by use of interdisciplinary field study, which can support technical teaching tied to themes of service-learning and civic engagement. This approach differs from most SL initiatives in that students participate in a highly structured pedagogical design, not only acquiring technical skills, but also serving a particular community. A SL subject in the form of a capstone project, Housing for the Community, was developed based on the three-tier service-learning model for validation of the model. The findings revealed that the subject was able to help students acquire the necessary technical skills for conducting building inspection, raise their awareness of civic responsibilities, and develop concern about the well-being of society.

Although the three-tier service-learning model has offered a pragmatic pedagogical model for upholding the transfer of technical knowledge and addressing social issues by use of interdisciplinary study, which suits SL for engineering and building faculties, this study has been limited to a single technical program that included a small number of students and households. More studies on the application of the model in other disciplines, such as

business and design arenas, and a wider coverage of students and households can help refine the model and enhance its adaptability.

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