ADDRESSING ACADEMIC AND COMMUNITY NEEDS VIA A SERVICE-LEARNING CENTER

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ABSTRACT

This paper describes the Service-Learning Center recently created as a result of the curricular reform of the School of Engineering of the Universidad Católica de la Santísima Concepción (UCSC), Chile. Its goal is to help students develop and strengthen their disciplinary knowledge and their personal and interpersonal skills through community service activities that expose them to real-world engineering-in-context experiences. The Service-Learning Center contributes to the university's strategic plan, which fosters integration with the community to promote both regional and national development, and to the university's mission, which is made manifest through 11 UCSC generic competences, matching several CDIO personal, interpersonal, and professional skills. To fulfill its goals, the Service-Learning Center must first diagnose community needs and then identify relevant problems that match the engineering programs' scopes and academic needs. Then, service-learning activities are designed by both instructors and community stakeholders. Once a project is agreed upon, it is developed by students in one or more courses. Assessment of the service-learning activities is twofold: first, instructors assess the achievement of the courses' learning outcomes; then, the Service-Learning Center assesses the achievement of its goals via surveys given to students, faculty, and community partners. Our preliminary results are encouraging, showing a high level of student satisfaction with their contributions to solving real community problems, strengthened collaboration among students and the community, and higher student commitment to their discipline. Moreover, data shows that the Service-Learning Center's role has been relevant in instilling students with the institutional hallmark and in forging lasting relationships between academia and the community. However, from the academic point of view, service-learning requires a high degree of commitment, instructor time and institutional resources. So far, few faculty had been trained in service-learning and extra efforts are needed to extend community bonds.

KEYWORDS

Service-learning, integrated curriculum, standards: 1, 2, 3, 5, 7, 8, 10 and 11.

INTRODUCTION

The UCSC School of Engineering is committed to improving the effectiveness of its teaching, so as to promote meaningful learning and engage students in their learning process. To this

end, in 2008 the UCSC School of Engineering began its curriculum reform process based on the CDIO initiative (Crawley, 2007) and the UCSC pedagogical model, a human-centered model based on a learning-outcome and competency-based curriculum, a student-centered teaching and learning approach, ethics-based education, and the integration of academia and society.

The Conceive and Design phases of this curriculum reform were guided mainly by CDIO standards 1 (CDIO is the context of engineering education), 2 (Learning outcomes) and 3 (Integrated curriculum) (Loyer et al., 2011). The Implementation phase was begun in 2011 and included five engineering programs. In particular, the first-year introductory courses were redesigned to provide the framework for engineering practice, in accordance to CDIO standard 4. Some encouraging results relative to the use of active learning (CDIO standard 8) in the introductory courses of Computer Science and Industrial Engineering programs were presented by Muñoz et al., (2013) and Cárdenas et al., (2013). A preliminary assessment of CDIO standards compliance showed considerable progress in standards 2 (level 4) and 4 (level 5), and fair progress (level 3) in eight of the 12 standards (CDIO, 2010; Martínez et al., 2013). In particular, these works showed the extensive coherence between the UCSC pedagogical model and the CDIO standards. Also, another result of this curriculum reform is the increased faculty commitment to standards 7 (Integrated learning experiences), 8 (Active Learning) and 11 (Learning assessment) for promoting academic achievement and positive student attitudes. At the same time, it is clear that enhancement of faculty teaching competence (CDIO standard 10) needs to be encouraged more aggressively.

Striving to both increase meaningful learning and students' social engagement, the School of Engineering has also implemented pilot experiences using the service-learning method in the context of helping communities affected by the 2010 Chilean 8.8 earthquake. Students from different disciplines such as engineering, marine biology, and social services worked together in several projects and studies. Later assessments showed high levels of student motivation, greater identification with their chosen disciplines, and improvement in personal and interpersonal skills. However, these activities were considered part of the students' complementary curriculum and were not a part of the core engineering curricula. Also, these activities usually were initiated and/or promoted by individual faculty members, lacking any centralized coordination, and with only minimal budget allowances.

Given these successful learning experiences and also as a result of the curriculum reform, in 2012 the School of Engineering created the *Centro de Aprendizaje-Servicio e Integración de Saberes* (ASIS), a service-learning center to help coordinate and organize these activities, to systematize data gathering processes, and at the same time to help brand its students with the institutional hallmark by strengthening the UCSC generic competences presented in Table 1, which match several CDIO personal, interpersonal, and professional skills.

This center was created via the 2011 FIAC2 USC1101 project funded by the Chilean Ministry of Education. One of its first activities was a workshop on service-learning and its application to undergraduate level courses, which was attended by 15 School of Engineering faculty members. This workshop was given by service-learning experts from the Pontificia Universidad Católica de Chile's Teaching and Learning Center. Among the workshop results were proposals for incorporating service-learning to the core curriculum of three engineering programs: Civil Engineering, Industrial Engineering and Computer Science. To date, the ASIS Center has supported the application of the service-learning method in courses such as Topography for Civil Engineering, Chemical and Heat Processes for Industrial Engineering and Databases for Computer Science, benefiting 191 students in 2013.

At the same time, the ASIS center has joined national and international collaboration networks, such as the Chilean *Red Nacional de Aprendizaje y Servicio* (REASE), and the *Centro Latinoamericano de Aprendizaje y Servicio Solidario* (CLAYSS), based in Argentina, and has participated in workshops and conferences in 2013 and 2014.

Recently, the Chilean Ministry of Education has funded the PM USC1308 project, which aims to help the School of Engineering programs boost its levels of compliance with the CDIO standards. This two-year project includes funding for the ASIS Center to promote service-learning so as to improve compliance levels with standards 1, 2, 3, 5, 7, 8, 10 and 11.

THE UCSC SCHOOL OF ENGINEERING SERVICE-LEARNING CENTER (ASIS)

The mission of the ASIS Center is to promote meaningful student learning in a real context by integrating academic curriculum and service-learning, and to educate engineers with solid principles, ethics and values, committed to serving the community. Its main objectives are to promote, coordinate and assess those service-learning activities of the School of Engineering undergraduate programs that facilitate the acquisition of disciplinary knowledge, aid the development of generic competences and promote interaction with other disciplines. Its specific goals include identifying liaison opportunities with potential community partners; training interested faculty in the application of the service-learning method to their respective courses in partnership with the UCSC Teaching and Learning Center (CIDD); defining a list of core curricula courses each semester that integrate disciplinary knowledge and service-learning; offering UCSC students multidisciplinary complementary curricula courses that apply the service-learning method; coordinating the development of curricular activities using the service-learning method; assessing the impact of service-learning activities in engineering education.

ASIS Center Organization

The ASIS Center is led by the Director, who oversees the center's operation in accordance to the center's objectives and goals, manages its resources, leads and supervises the center's activities, and chairs the Advisory Board, which counsels the director in the center's strategic planning, advising its development and service areas. The planning, coordination, management, control and assessment of the center's activities and resources is done by the Management Unit, which also disseminates the center's activities both across academia and the community. Its two divisions are the Community Relations Division, and the Academic Management Division. The first one is responsible for maintaining stable and effective relationships with relevant community partners, identifying suitable community opportunities for service-learning and working out service-learning agreements with community stakeholders. The second one coordinates community intervention activities with the undergraduate program directors, manages, controls, coordinates and assesses the service-learning activities, maintains a list of course offerings that include service-learning activities and trains interested faculty in applying the service-learning method to their respective courses in partnership with the UCSC Teaching and Learning Center (CIDD).

THE SERVICE-LEARNING PROCESS

The ASIS center puts service-learning into practice by executing four stages, Diagnostic, Planning, Implementation and Assessment, as shown in Figure 1.

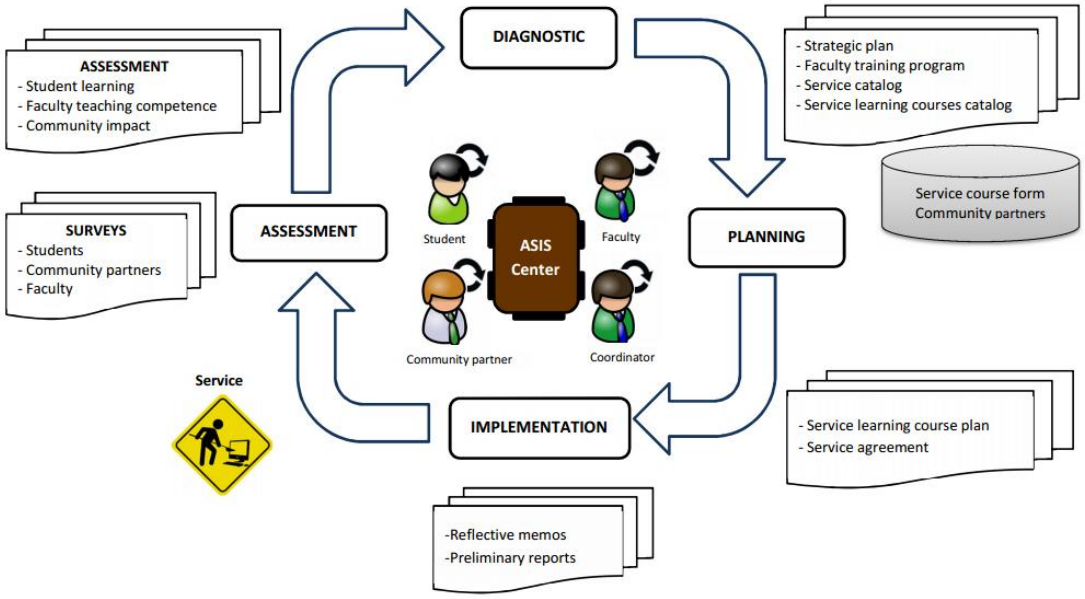

Figure 1: Stages of the service-learning process at the ASIS Center

In the Diagnostic stage, the Academic Management Division identifies courses that might provide opportunities for service-learning in accordance to the ASIS Center's strategic plan, and generates a catalog of potential services to be presented to the community stakeholders, and a list of faculty interested in integrating service-learning activities in their courses. Then, the Community Relations Division meets with community stakeholders to present the service catalog and relate it to the community's needs. Finally, the Academic Management Division and the UCSC Teaching and Learning Center jointly generate a Faculty Training Program for those instructors that wish to incorporate service-learning methods in their classes.

The process enters the Planning stage once a service-learning course is matched to a community need. The course instructors and Management Unit personnel meet with community stakeholders to define a service framework specifying roles, timeframes and services to be rendered by the students, and an activities plan is agreed upon. This agreement is officially formalized in public with the attendance of all stakeholders.

All stakeholders work together in the Implementation stage to put the agreement into practice, and perform the defined service-learning activities. The progress of both student learning and services to the community are monitored via preliminary reports and reflective memos.

In the Assessment stage, the service-learning activities are evaluated by surveying community partners, students and faculty on several topics such as the service-learning method, achievement of learning outcomes both related to disciplinary knowledge and to personal and interpersonal skills, and community relationships. This data is systematized and analyzed for continuous process improvement and future services development.

COURSES WITH SERVICE-LEARNING ACTIVITIES

In 2013, service-learning has been applied in three courses: Topography for Civil Engineering, semesters I and II, Chemical and Heat Processes for Industrial Engineering,

semester II, and Databases for Computer Science, semester II. The following paragraphs briefly describe each service-learning activity, indicating learning outcomes, community partners, and generic competences addressed by the course. Table 1 presents a mapping of UCSC generic competences to the CDIO Syllabus. (Crawley et al., 2011).

Table 1. CDIO Syllabus goals and UCSC Generic Competences mapping

CDIO Syllabus goals		UCSC Generic Competences
Personal and professional skills and attributes	2.2.2 Survey of print and electronic literature	GC7
	2.4.1 Initiative and the willingness to make decisions in the face of uncertainty	GC6
	2.4.2 Perseverance, urgency and will to deliver, resourcefulness and flexibility	
	2.4.2.6 Adaptation to change	GC8
	2.4.5 Self-awareness, metacognition and knowledge integration	
	2.4.6 Lifelong learning and education	GC4
	2.4.7 Time and resource management	
	2.5.1 Ethics, integrity and social responsibility	GC2
	2.5.5.1 A commitment to treat others with equity	CG1
	2.5.5.2 Embracing diversity in groups and workforce	
Interpersonal skills: teamwork and communication	3.1 Teamwork	GC5
	3.2 Communication	GC3
	3.2.4 Electronic/Multimedia communication	GC10
	3.3.1 Communications in english	GC11
Conceiving, designing, implementing and operating systems in the enterprise and societal context	4.1.1 Roles and responsibility of engineers	
	4.1.2 The impact of engineering on society and the environment	
	4.2.1 Appreciating different enterprise cultures	
	4.3.1 Understanding needs and setting goals	
	4.3.4 Development project management	
	4.8 Engineering entrepreneurship	GC9

Topography for Civil Engineering

Topographic surveys were chosen as service-learning activities for this course. The activities' learning outcomes are: use of the total station for topographic surveys, earth moving calculations and general topographic analysis, and use of digital topography software for topographic map analysis and understanding. The activities' generic competences are GC6, GC10, and CDIO 2.4.7. In 2013-I, students surveyed the *David Fuentes* hill for its neighborhood association and the *Talcahuano* municipal government, and in 2013-II students surveyed five rural schools for the *Hualqui* municipal government.

Chemical and Heat Processes for Industrial Engineering

In this course, heat-transfer operations diagnosis was chosen as the service-learning activity. The activities' learning outcomes are: identify and characterize mass and energy transfer operations and propose improvements, and interpret and analyze the basics of equipment evaluation. The activities' generic competences are GC5 and GC6. In 2013-II, students diagnosed the *Taller Protegido Los Pioneros* laundry, which is staffed by disabled youth.

Databases for Computer Science

In this course, the design of a database system was chosen as the service-learning activity. The activities' learning outcomes are: understand and utilize a database management

system, design and implement a database system. The activities' generic competences are GC2, GC5 and GC10. In 2013-II, students worked with the *Taller Protegido Los Pioneros* laundry, which is staffed by disabled youth.

RESULTS AND DISCUSSION

In the following section, we present some preliminary results about the service-learning activities done in 2013 in the three courses, which were gathered via standardized surveys given by the ASIS Center. Thus, they include questions related to several CDIO learning outcomes, many of which are not explicitly declared as learning outcomes for a given course.

Assessing CDIO Skills/UCSC generic competences

In general, preliminary student survey results presented in Figures 2, 3 and 4 are very encouraging. Results for the Topography and Databases courses are similar, while results for the Chemical and Heat Processes course are slightly lower. In the latter case, the course instructor decided to incorporate service-learning activities on the fly after the start of the semester, when he became familiarized with the Databases course experience. These results are also consistent with the results of faculty surveys. However, the latter focus mainly on those learning outcomes that they consider relevant to their particular course.

Student opinions gathered through reflective memos are consistent with their perception of service-learning usefulness for CDIO skills acquisition. Students find service-learning activities to be stimulating and gratifying and that they are great motivators for them to do quality work, not only to earn a good grade but also to give a high-quality service to their community. Moreover, they appreciate the instructor consulting hours more, and the importance of effective teamwork. At the same time, students recognize the need for better planning at the beginning of the semester, and comment on the necessity of having teaching assistants to help large classes when doing fieldwork. These comments are consistent with faculty opinion of the service-learning activities, who also state that they require more support from the ASIS Center when planning activities at the beginning of the semester, and when following up activities during the semester.

Assessing the Impact on Faculty Teaching Competence

Regarding the results of the faculty surveys on their service-learning activities presented in Figure 5, instructors recognize that using the service learning method has improved their teaching skills, plan to incorporate it into their teaching practice and use it again in the future. Most importantly, they feel that students' learning outcomes achievement level is higher when using the service-learning method than when using traditional in-class methods.

Faculty reflective memos yielded several additional comments. Instructors found that service-learning activities highly motivate students but, nevertheless, they recognize the need for better planning and support from the ASIS center, especially to better understand community needs before engaging in a service agreement. Several instructors commented on the higher demands that service-learning places on their time, responsibility and dedication, and the need to better coordinate the dates of service-learning activities such as fieldtrips with faculty and student academic schedules. Finally, instructors also recognize the positive impact service-learning activities had on their teaching, by having them guide and supervise motivated students on a real-world project.

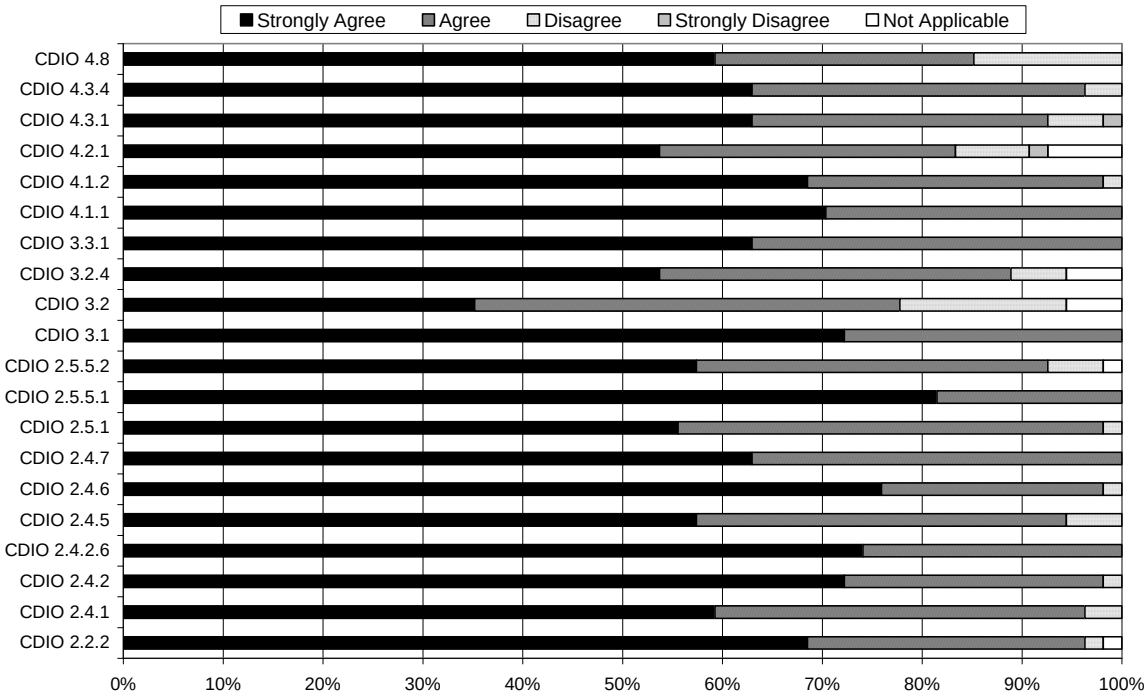

Figure 2: Topography students' perception of S-L usefulness for CDIO skills acquisition

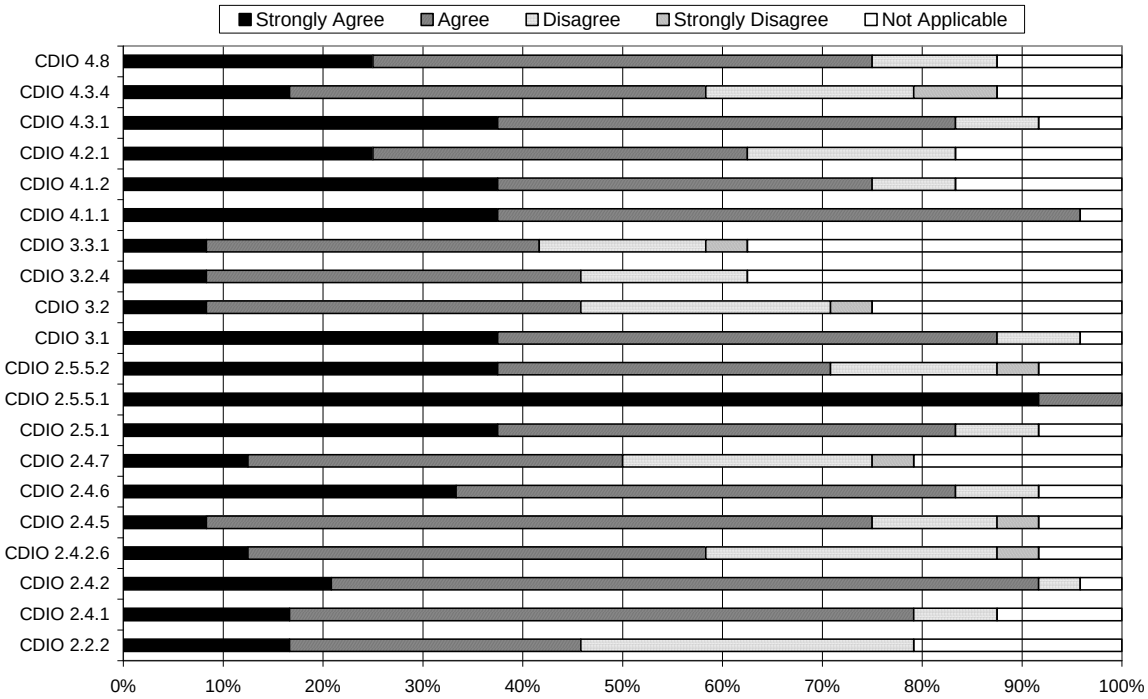

Figure 3: Chemical and Heat Processes students' perception of S-L usefulness for CDIO skills acquisition

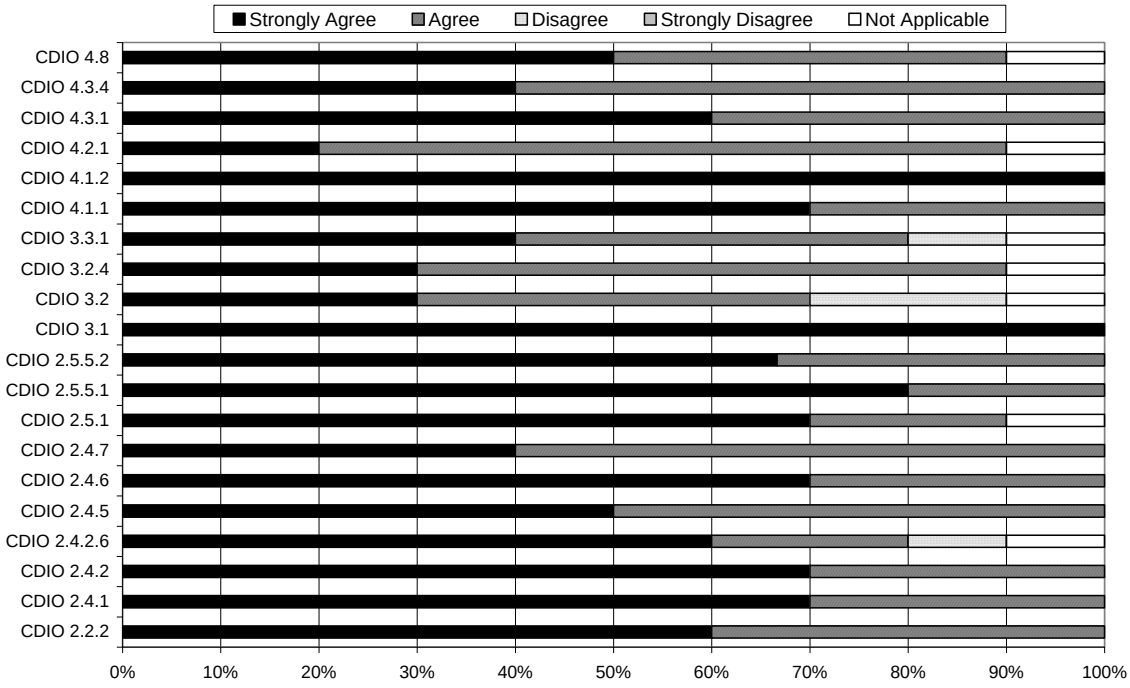

Figure 4: Databases students' perception of S-L usefulness for CDIO skills acquisition

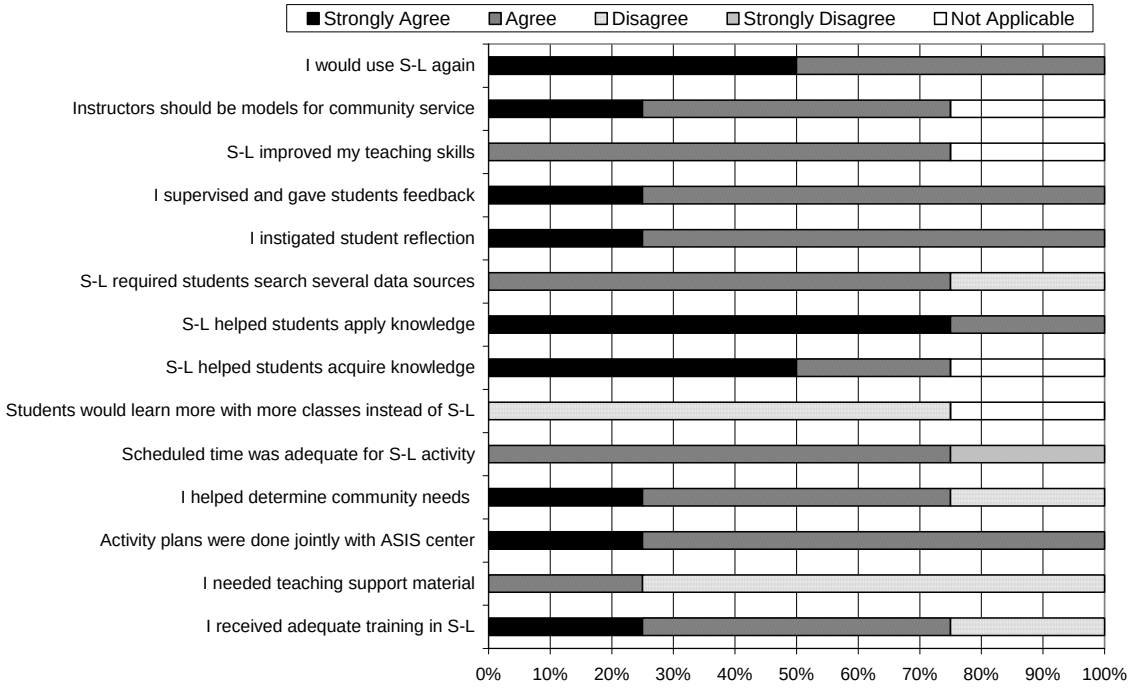

Figure 5: Overall faculty perception of S-L impact on their teaching practice

Assessing the Impact on Community Relationships

Figure 6 presents the overall faculty perception of community relationships. It can be seen from the surveys that instructors consider service-learning to be very useful for strengthening

community ties, raise awareness among students and faculty of their community's needs and engage them in the process of finding solutions to them.

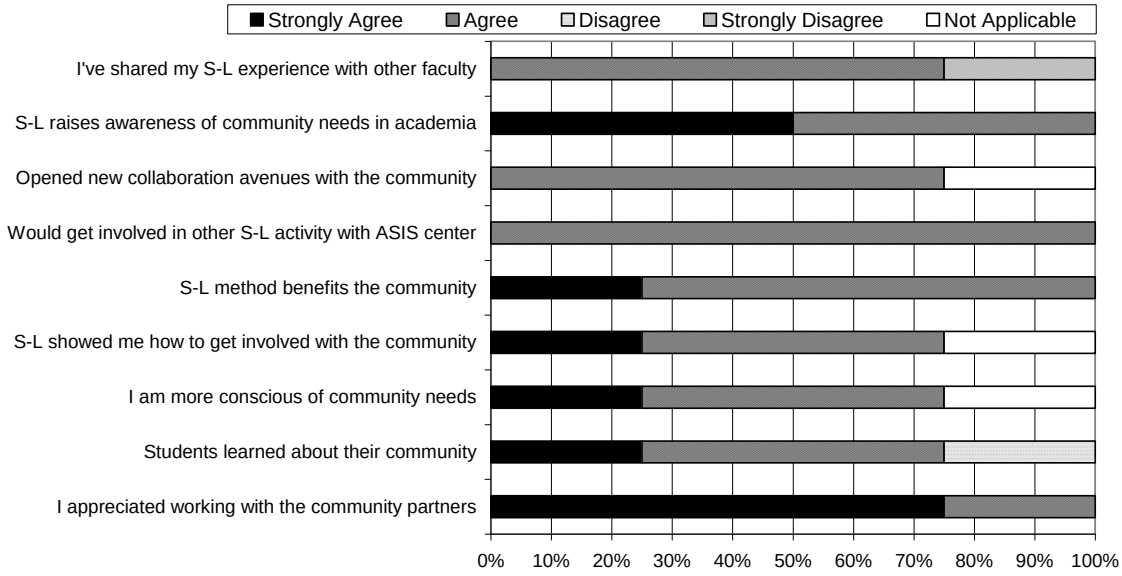

Figure 6: Overall faculty perception of community relationships

To date, we have worked with only three community partners of which one hasn't yet completed the surveys. Therefore, we only present qualitative results from reflective memos as we do not currently possess statistically significant survey results.

In general, our community partners greatly value the students' and faculty enthusiasm, positive attitude and awareness of community needs. They were also satisfied with the services rendered, even though in some cases they still haven't received the final products. They recognize the magnitude and difficulty of the tasks to be performed, and wish that they had had more time to support the students in the field. Finally, they suggest that the ASIS Center service catalog be expanded to include more services.

CONCLUSIONS

Preliminary results of using service-learning in three courses reveal that students feel gratified by their acquisition of technical, personal and interpersonal CDIO skills while solving real community problems (Standards 1, 2, 3, 5, 7). Moreover, community partners were grateful for the services rendered by the students, feel that these activities brought academia closer to the community and hope to strengthen ties for future collaboration. Likewise, faculty were satisfied with the service-learning method regarding student learning outcomes achievement and closer community relationships (Standards 8, 11), even though they find that service-learning places higher demands on their responsibility, dedication and time (Standard 10). Finally, the ASIS center faces several challenges such as expanding its service-learning course catalogs, increase faculty training and motivation, develop certifications for faculty and students, improve the center's coordination with community stakeholders, raise awareness of the center's activities at local and national levels, and strengthen ties to national and international service-learning networks.

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Patricio Cea is a faculty member in the Industrial Engineering department at UCSC, where he serves as undergraduate program director. He is also the ASIS Center's Academic Management Division head. His research interests are transport economy and logistics.

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