EVALUATING A SERVICE-LEARNING EXPERIENCE IN GEOLOGICAL ENGINEERING, UCSC, CHILE

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ABSTRACT

This work presents the results of assessing the impact on students of the implementation of the Service-Learning methodology in the Geological Risks course of the Geological Engineering program at the Universidad Católica de la Santísima Concepción. This experiential methodology (Standard 7, 8) integrates learning objectives and community needs with a strong participatory and reflective approach. To assess this implementation, an anonymous and voluntary Likert-type survey was applied to the students, which considered four dimensions: disciplinary knowledge and reasoning (CDIO 1.3), personal and professional skills and attributes (CDIO 2), interpersonal skills (CDIO 3.1 and 3.2) and CDIO in the enterprise, societal and environmental context (CDIO 4.1, 4.2 and 4.3). Results show that 100% of the students positively value the service-learning experience, related to the fact that it helped them put into practice knowledge, methods and/or disciplinary tools, while 95% stated that it allowed them to identify the strengths and weaknesses of their technical knowledge. Also, they remarked that it fostered decision making (90%), perseverance in achieving the objectives (86%) and the assessment of ethical behaviour in their profession (95%). At the same time, they highlight the importance of teamwork (86%), the development of communication skills (81%) and awareness of the discipline's impact in today's society (90%). Our results show that the service-learning experience fostered the development of skills, attitudes and values necessary for the students' conduct in today's society, reinforcing this methodology as an aid for comprehensive and meaningful learning. Finally, all stakeholders must carry out a permanent reflection relating to the implementation and results of these experiences in order to make adjustments and improvements for the benefit of the learning process.

KEYWORDS

Active learning, Service-Learning, Engineering education, Standards: 7, 8

INTRODUCTION

The Universidad Católica de la Santísima Concepción (UCSC)'s current educational model is based on competencies and learning outcomes that foster student-centred learning. In this context, an important milestone is acquiring the Commitment and Social Innovation competence, which is developed across the curriculum through the philosophical-theological coursework and through the implementation of the Service-Learning methodology (S-L) in a required course. This competence seeks to educate students capable of contributing solutions to the community's real needs in the context of solidarity activities for the benefit of the common good.

At the same time, since 2011, the School of Engineering adheres to the CDIO (Conceive-Design-Implement-Operate) Initiative, which proposes an educational framework for engineering education. This framework defines 12 standards, aimed at producing professionals up to the challenges and needs of today's society (Crawley, Malmqvist, Ostlund and Brodeur, 2007). At the same time, the School of Engineering fosters the use of the Service-Learning methodology as part of its institutional seal (Cea et al., 2014).

This work presents an impact assessment, from the student's perspective, of the implementation of the Service-Learning methodology in a course of the UCSC geological engineering program. This evaluation considers items related to knowledge and disciplinary reasoning (CDIO 1.3), personal skills (CDIO 2) and interpersonal (CDIO 3.1 and 3.2), and CDIO in the business and social context (CDIO 4.1, 4.2 and 4.3).

In the next section, we present the theoretical aspects of this methodology, followed by background information about the implementation and the evaluation processes. Finally, we present conclusions and remarks about the educational process.

FRAMEWORK

Service-Learning is a teaching and learning methodology that links educational institutions and social entities, generating a virtuous circle that allows students to achieve effective learning through community service (Brodeur, 2012; Batlle, 2015). Thus, Service-Learning serves as a powerful educational tool that fosters meaningful learning through experience (CDIO Standard 7, 8), contributes to social awareness and community problem solving, and fosters students' values development (Jouannet, Salas & Contreras, 2013). Likewise, for Aramburuzabala, Cerrillo & Tello (2015), Service-Learning not only facilitates the acquisition of knowledge, but it is also a model of sustainable development for students, since in practice they develop services for social and environmental sustainability. Similarly, Sotelino, Mella & Rodríguez (2019) point out that this methodology contributes to the students' civic-social development, increasing their commitment and civic participation.

This methodology's implementation requires that the educational process incorporate reflection as an articulating axis, so that students understand the scope of their intervention in the community, thus giving new meaning to the service performed (Jouannet, Salas & Contreras, 2013).

In general, higher education institutions have initiated substantial changes in their educational models, incorporating teaching and learning methods focused on experience and action, in order to ensure quality educational processes (Silva & Maturana, 2017). From that perspective, the Service-Learning methodology is considered an innovative practice, since it fosters situated learning, that is, the application of knowledge in a real environment generating benefits in society (Zabala-Guirado, González-Castro & Vásquez-García, 2020).

SERVICE-LEARNING IMPLEMENTATION

In the context of the educational model of this institution and the CDIO framework, the UCSC geological engineering program has implemented the Service-Learning methodology in the Geological Risks course since 2016. This course belongs to the 9th semester of the 11-semester program.

In this work, we present results corresponding to the 2019 version of this course, which had an enrolment of 29 students. The goal of the service defined for this course is to generate technical documentation to support decision making in the field. In this case, the technical documentation consisted of evaluating the geological risks associated with mass wasting processes present in the town of Caleta Chica de Cocholgüe, Tomé municipality, Biobío region, Chile, with the purpose of advising the community about its tourism prospects, an explicit need expressed by the social partner. The model proposed by Batlle (2015), used for the School of Engineering Service-Learning projects, was followed for the project planning. This model is shown in Figure 1.

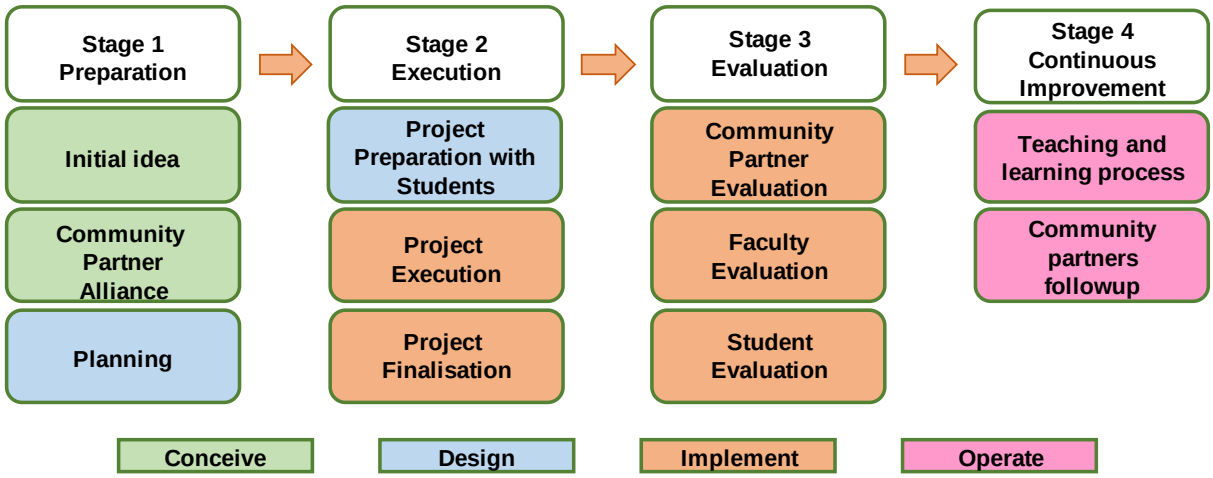

Figure 1. Service-Learning Project Development Stages and their Relationship to CDIO Stages (based on Batlle, 2015)

In the preparation stage, the Geological Risks faculty along with the School of Engineering Service-Learning projects coordinator worked on an initial idea for the project, defining where to carry it out, detecting possible community needs and identifying the potential service to be performed. Additionally, they specified the knowledge, attitudes and values to be reinforced through this experience. To confirm the project's viability, a meeting with the Cocholgüe community's social representatives was held, to know their real needs, define the service to be done by the students, and to agree on cooperation and coordination strategies (Conceive). A written document was obtained as an output of this Community Partner Alliance, in which both parties state their commitments to the Service-Learning project development. Finally, we plan the service, specify the project's pedagogical aspects and specify other matters related to its organization and management.

The execution stage considers an initial project preparation with the students, in which a reflection session was held to sensitize the group regarding the project's social needs emphasizing the importance of each student's commitment and actions. As a result, students understood the service to be performed, its usefulness to the community partner and the learning outcomes they would achieve through the project development. Also, working groups were set up and each student's responsibilities within them were specified. Additionally, the work schedule was defined together with the students (Design). The project execution (Implement), as such, allowed promoting real-life learning, reinforced aspects such as attendance, punctuality and work rigour, and provided an opportunity for communication with the project's beneficiaries. Figure 2 shows the methodology implemented by the students to develop the Service-Learning project and its technical report, which is the

service's final product. It details the work done before the two days of fieldwork, the fieldwork itself and the work performed after. Project finalization involved delivering the technical report to the community partners (Figure 3) and a reflection activity on the service performed and the learning outcomes achieved through its development. Also, there was an activity designed to show the service's results throughout the community. At the same time, the project itself was promoted to the rest of the educational community through the institutional website (UCSC, 2019).

The evaluation stage integrates several approaches so as to obtain a comprehensive vision of the Service-Learning experience. The next section describes the evaluation process in greater detail. Evaluation results are used as input to improve the Geological Risks course and the Service-Learning project to be performed the next academic term. At the time of this paper, the community partners followup and feedback after delivery of the final report was still pending (Operate).

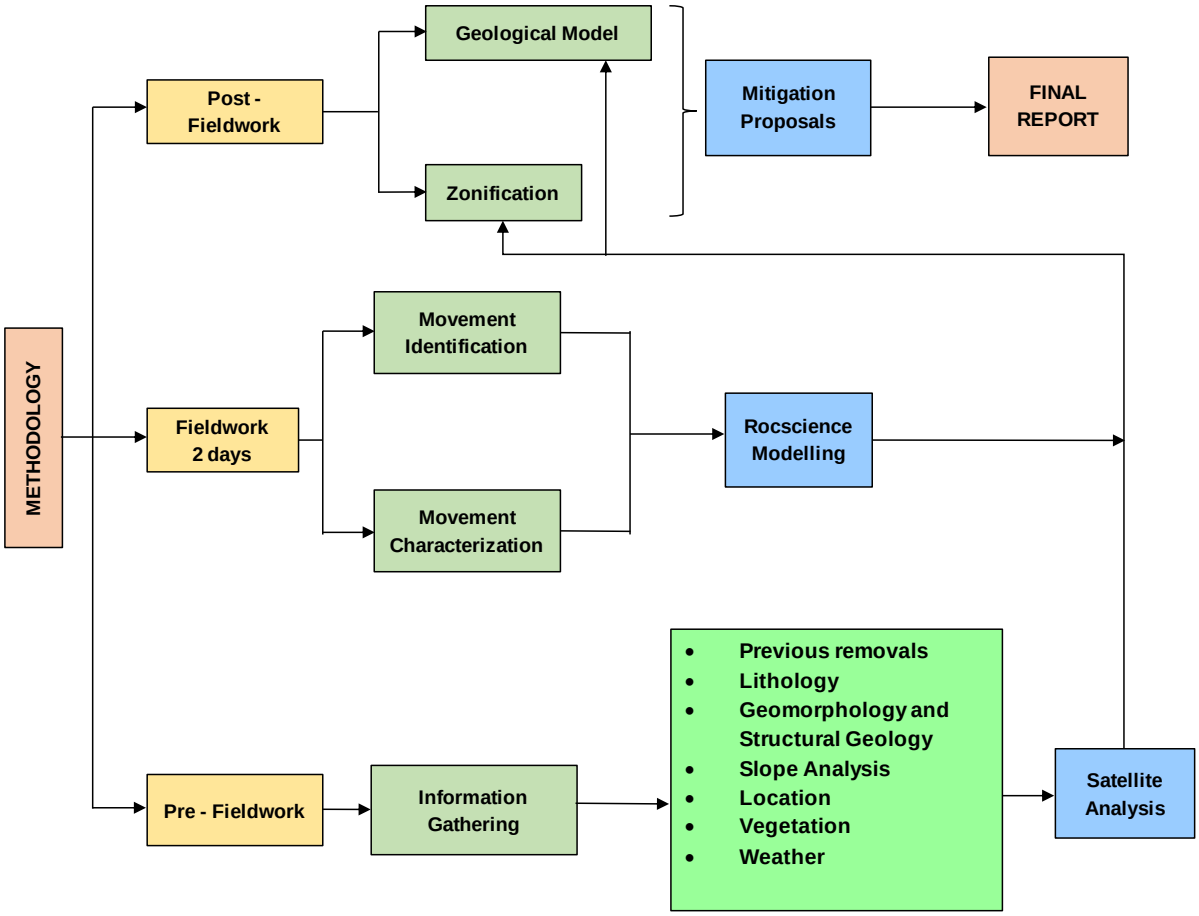

Figure 2. Service-Learning Project Methodology (Cea & Fernández, 2019)

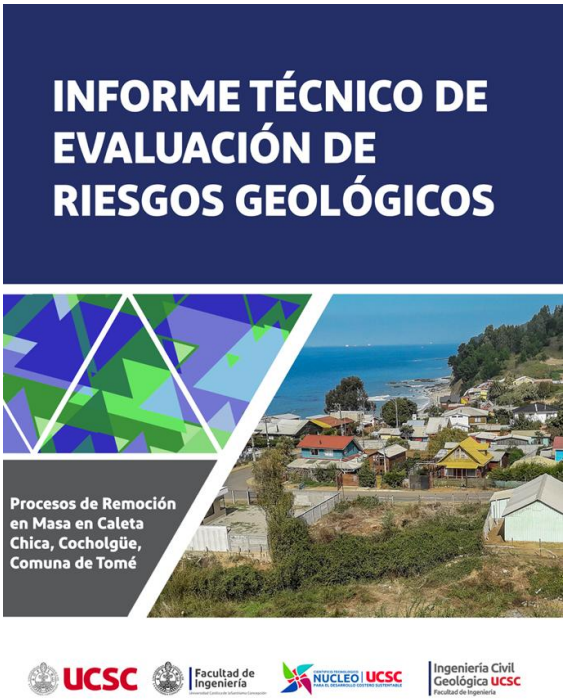

Figure 3. Final Report handed to community partner. (Cea & Fernández, 2019)

SERVICE-LEARNING PROJECT EVALUATION

The Service-Learning project evaluation as a whole had reflection as its central axis and integrates input from all participating stakeholders: community partner, faculty and students.

For this article we present preliminary results of the students' impact evaluation done once the service is finished. The evaluation is a Likert-type questionnaire, of an anonymous and voluntary nature, consisting of 21 items, in which the following aspects were evaluated: Disciplinary knowledge and reasoning (CDIO 1.3), personal skills (CDIO 2.1, 2.2, 2.4 and 2.5), interpersonal skills (CDIO 3.1 and 3.2) and CDIO in the business and social context (CDIO 4.1, 4.2 and 4.3). Answers ranged from strongly disagree to strongly agree.

Table 1 shows the statements of the 21 items that make up the questionnaire applied to the students and their relationship with the CDIO syllabus competences. This questionnaire was answered by 100% of enrolled students. Figure 4 shows the results obtained from the student impact evaluation questionnaire for all 21 items. Only the sum of the "agree" and "strongly agree" answers are plotted in relation to each statement.

Results show that, in general, students evaluate the Service-Learning experience in the Geological Risks course positively. Specifically, 100% of students indicated that they strongly agree or agree that the activity allowed them to put into practice the knowledge, methods and/or disciplinary tools. Regarding the CDIO personal skills, 95% of them stated that it allowed them to identify the strengths and weaknesses of their technical knowledge. Likewise, they also positively evaluated the project related to the fact that it promoted decision-making (90%), perseverance in achieving the objectives (86%) and allowed them to assess self-learning (95%) and ethical behaviour in the exercise of their profession (95%).

Table 1. Questionnaire Statements and related CDIO syllabus competences.

ITEM	CDIO	STATEMENTS
1	1,3	Working in this activity allowed me to put into practice theoretical concepts seen in classes in this or other subjects
2		I could appreciate the importance of using disciplinary methods and/or tools in the activity development
3	2,1-2,2-2,4-2,5	I had to search and analyze information from different sources to understand the problem and propose a solution
4		I was able to make decisions and defend them before my team
5		For the service learning activity to succeed, I had to work constantly and persevere to achieve the goals
6		This activity helped me be flexible and improved my ability to adapt to changes
7		Working in this activity helped me identify my technical knowledge's strengths and weaknesses
8		This activity helped me realize the importance of self-learning for professional development
9		I had to properly manage time and resources in order to reach the activity's goals
10		Working with the community allowed me to value the importance of ethical behavior in my profession
11		Working on this activity fostered my commitment to respect other participants
12		Working with the community partner helped me connect to other professionals and/or people from other places and realities
13	3,1-3,2	Through this activity I realized the importance of being able to work in a team
14		Through this activity I was able to improve my oral and written communication skills
15		Information and communication technologies helped achieve the activity's goals
16	4,1-4,2-4,3	Defining the roles and responsibilities of the work team members was essential for the activity's development
17		The development of this activity helped me realize the impact of my discipline on society and on the environment
18		Through this activity I was able to meet different organizational cultures
19		I was able to understand the community partner's needs and use them to define goals
20		Planning, control and evaluation of the activity's development helped achieve the objectives
21		This activity helped me develop my entrepreneurship and innovation skills

Figure 4. Student impact evaluation (%).

Regarding CDIO interpersonal skills, 86% of students agree or strongly agree that the Service-Learning project helped them assess the importance of teamwork, while 81% of them indicated that it was an opportunity communication skills development and that the use of technological resources aided achieving the service's goals.

Similarly, they agree that the activity helped them recognize the importance of proper planning, control and evaluation in achieving the objectives (100%) and allowed them to understand the needs of the community partner (90%) and become aware of the impact of discipline in today's society (90%).

Overall, our results show a very positive evaluation of the experience's impact. However, more work is needed on aspects such as time management, linking with professionals from other areas, closer contact with different organizational cultures and the development of innovation and entrepreneurship skills. Specifically, in these items students' positive evaluation is between 67% and 76%. Even though these percentages are reasonably good, they are the lowest results for the questionnaire.

CONCLUSIONS AND FINAL REMARKS

Our results show that the Service-Learning experience led geological engineering students to develop those skills, attitudes and values necessary to meet the demands of today's society, validating, in this way, this methodology for the benefit of comprehensive and meaningful learning. Considering this last aspect, it is important to emphasize that this experiential methodology allows students not only to acquire knowledge and problem-solving strategies related to their area of expertise, but also fosters behaviours, values and attitudes that allow them to become an ethical professional conscious of their social responsibilities and an engaged and committed citizen.

The students' impact evaluation results show a very positive opinion of the Service-Learning experience. At the same time, students improve their confidence and self-perception. The results obtained in the impact evaluation applied to the students, of the Geological Risks course, show a very positive assessment of the vivid experience and an improvement in the perception of themselves. Even though this paper bases it results on only one application of the questionnaire, we have systematized the assessment process so as to gather data from future Service-Learning experiencies to guide our continuous improvement process both regarding our teaching and learning processes and our community partnerships.

Finally, it is important to hold reflection activities with all stakeholders throughout the entire process to benefit not only the expected and achieved learning outcomes but also to benefit the continuous improvement process that ensures a high-quality learning process.

Regarding future work, we are aiming to incorporate and contrast the impact evaluation of students' Service-Learning experiences among several courses in order to assess the methodology's impact and compare it to other approaches. Also, we intend to follow up with our community partnerships to assess the projects' impact on the community through time.

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