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Active Learning and Soft Skills in Engineering: Two Experiences Involving Community Engagement

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Abstract. Two optional workshops of the School of Engineering of the Universidad de la República (Uruguay) are presented, which implement active learning methodologies to develop soft skills through working with different community actors. The workshops involve Computer Engineering students at different career stages and address specific contents of the disciplines through work with members of educational centers and small enterprises. Classroom observations and interviews were conducted to characterize these courses and gather students' opinions. Common characteristics were identified in both workshops that show active learning in the proposals, the relevance of interaction with community actors, and the development of soft skills, including teamwork, communication, real problem-solving, autonomy and empathy. The students evaluated the proposals positively and highlighted the contributions of developing projects based on the link with non-university actors. Although they referred to the challenges and difficulties involved in this distinctive approach, they valued the opportunity to put their skills into practice. It is hoped that the analysis of these experiences will provide useful elements for the development of more proposals that integrate active learning, the development of soft skills and community collaboration in engineering education.

Keywords: Active Learning, Soft Skills, Experiential Learning, Engineering Education.

1 Introduction

Soft skills (SS) are increasingly essential in engineering education (EE). Strengthening SS as problem-solving, communication, and empathy challenges teachers to look for teaching strategies that offer specific spaces for their formation. The ongoing doctoral work titled "Exploring Innovative Teaching Strategies for Engineering Education: Insights from the School of Engineering (FI) at Universidad de la República (Udelar)" allowed identifying courses that promote SS development through active learning (AL) proposals involving students and community actors. AL integration based on projects that include non-university actors' participation presents an opportunity for engineering students to apply specific knowledge and develop SS relevant to their training.

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Udelar and FI promote AL development (Udelar, 2011; FI, 2016) and the integration of university outreach into the curriculum (Udelar, 2009).

This contribution focuses on two selected experiences involving Computer Engineering (CE) students, which are conducted in workshop mode. In these workshops, project development occurs through the interaction between students and community actors.

2 Theoretical Framework

SS, or general skills in education, encompass interpersonal and communication skills, problem-solving, analysis, synthesis, and critical judgment (Boyce et al., 2001). In EE, developing complex problem-solving skills; producing solutions that consider global, cultural, social, environmental, and economic factors; effective communication with a variety of audiences; recognizing ethical responsibilities; and teamwork are crucial (ABET, 2023; Samavedham & Ragupathi, 2012). It is increasingly important to implement hands-on training and student-centered teaching methodologies (Holik & Sanda, 2020).

AL promotes the development of SS in students by emphasizing experiential learning, creativity, and teamwork (Bonwell & Eison, 1991; Prince, 2004; Hartikainen et al., 2019).

Proposals that implement AL in engineering, focusing on teamwork for real problem-solving and project development through interaction with community actors, are effective in fostering the development of SS (Scherrer & Sharpe, 2020; Stolk & Martello, 2015). However, proposals with these characteristics can also pose difficulties for students, such as academic, social, or individual aspects (Laguador & Chavez, 2020; Patterson, 2018).

3 Methods

Two elective workshops (W1 and W2) were purposefully selected to identify AL features in the proposals that emphasize SS development and community outreach. Their general characteristics are presented in Table 1.

Qualitative data collection took place during the 2nd term of 2022, including classroom observations (CO) and interviews with students (Table 1). CO were conducted at different times, using a protocol, covering classes with different characteristics. Interviews, voluntary participation, were conducted at the end of the term using a semi-structured guideline. The research questions (RQs) guiding the analysis are:

RQ1: What are the main characteristics of the AL proposals?

RQ2: What SS are developed from the link with the community?

RQ3: What positive and negative aspects do students highlight?

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Table 1. General characteristics of each workshop.

	W1	**W2**
Career stage	Beginning	Mid-to late
Hs/wk dedication	6	8
Core content	Robotics	Innovation & creativity
Proposes	Robotics training experiences	Development of innovative solutions
Community	Educational centers	Small enterprises
Nº Students	17	16
Nº CO	4	4
Nº Interviewed Students	4	4

4 Results

CO revealed common AL characteristics in both workshops, such as small group work inside and outside the classroom, project development based on real-world problems through interaction with non-university actors, dedicated interaction time with those actors, and classroom spaces prioritizing student activities over teacher presentations. Teachers assumed the role of learning guides, fostering a positive classroom climate, and cultivating close student-teacher relationships. Each workshop offered diverse opportunities for developing of SS, creating an environment conducive to effective learning.

In W1, the community link observed was more initial, with proposed projects centered around introducing robotics activities to educational institutions. Contrastingly, in W2, the community presented a problem that prompted continuous exchanges between students and community members. This collaborative effort ultimately led to the development of a prototype solution.

According to the interviews, students from both workshops described them as different, interesting, and good, highlighting the emphasis on hands-on activities. They emphasized the development of various SS, including problem-solving, teamwork, autonomy and time management, communication, and empathy. The link with community actors was recognized as a distinguishing feature of these courses, facilitating the development of SS, although it also posed challenges. Difficulties were associated with the workshop's practical approach, which prioritized the application of SS through work with the community.

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5 Discussion

RQ1: The findings from both workshops highlight common AL characteristics aligned with community-based project development. Teamwork was prioritized, allowing ample time for interaction and discussion within student groups. However, a distinction emerged between W1 and W2. W2 emphasizes pre-planning, featuring distinct proposals for each class to enhance teamwork and prepare students for interaction with community actors. Conversely, W1 focused on general group work with less structured tasks, emphasizing hands-on work in class to enhance their performance.

RQ2: Both workshops prioritize developing SS through interaction with non-university actors, emphasizing teamwork, communication, real problem-solving, autonomy, and empathy. However, W2 demonstrates strengths compared to W1, going deeper in identifying and designing solutions with higher complexity. Differences can be attributed to students´ progression in the program; W1 is offered early on, while W2 occurs in the middle-to-late stages, resulting in varied emphases and challenges. Nevertheless, in both workshops, the connection to real-world problems and community enhances SS development, reinforced by alignment with specific timeframes and realities. This diversity offers students varied AL experiences linked to the community, with each workshop contributing uniquely to their educational growth, a positive aspect of providing diverse AL proposals.

RQ3: Students value and perceive the workshops positively, appreciating their defining characteristics. However, they also acknowledge the challenges of implementing all the proposed activities. These challenges, though, are seen as opportunities for growth and development. Students recognize that these courses are different from others, requiring them to adapt their usual strategies. It underscores their appreciation for being challenged and their understanding that venturing beyond their comfort zone enhances their learning experiences.

6 Conclusions

This contribution focuses on three key topics in EE research: training needs, AL methodologies, and community-linked experiential training. The analysis of two workshops reveals that CE students have access to distinct training opportunities, fostering community engagement. This highlights the potential for ongoing community involvement throughout the curriculum. The analysis aims to contribute to proposal development, identify best practices, and promote community-based activities for engineer training. Moreover, this approach provides a valuable opportunity to integrate SS through AL in community settings, significantly enhancing their development in ways that may not be addressed elsewhere.

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7 Limitations and Future Research

The analysis is based on one edition of each workshop. The ongoing doctoral work will include additional courses and teachers' perspectives.

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