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PAPER

Active Learning, Community Engagement, and Soft Skills Development: Insights from Four Engineering Courses

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ABSTRACT

This paper investigates four engineering courses that incorporate active learning, community engagement, and soft skills development into their design. These elements, recognized as essential in engineering education, enhance learning by promoting practical skills, real-world problem-solving abilities, and community engagement. Using a qualitative methodology, the study combines program review, non-participant classroom observations, and interviews with teachers and students to identify key elements, examine practical implementation, and highlight strengths and challenges. The results reveal flexible, student-centered service-learning designs tailored to diverse engineering contexts and communities, the integration of technical knowledge with real-world applications, and a strong focus on developing soft skills. However, challenges identified include low enrollment, limited institutional support, restricted opportunities for student reflection, and lack of feedback from community partners. This analysis provides practical insights into the strengths and limitations of integrating active learning, community engagement, and soft skills development into engineering courses and offers guidance for future curriculum design and implementation.

KEYWORDS

active learning, soft skills, community engagement, service-learning, engineering education

1 INTRODUCTION

This study explores the integration of active learning, community engagement, and soft skills development in engineering education through the analysis of four courses at the Faculty of Engineering of the Universidad de la República (Udelar), Uruguay.

Over the past decade, innovative teaching strategies have been developed at the Faculty of Engineering (Udelar), aligned with Udelar's central guidelines [1]. As a Latin American public university committed to community engagement since its

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inception, Udelar focused on integrating community engagement into the curriculum from 2009—in the context of a "second university reform" – with the aim of making it a common aspect of various courses, and not just specific projects or voluntary extracurricular activities [2], [3]. As [2] points out, with integration into the curriculum, "community engagement can transcend its marginal place and have a more solid academic and institutional framework."

Despite these efforts, the integration of community engagement into the curriculum of the Faculty of Engineering (Udelar) remains limited, reflecting the broader challenges faced by public universities in the region. These include balancing growing student populations with limited human and material resources, which hinders the transformation of teaching practices [4]. In addition, the pedagogical conceptions and practices associated with community involvement are heterogeneous [2]. To address these constraints, it is necessary to strategically plan curricula to integrate active learning initiatives at critical junctures, foster skills and competencies, and strengthen connections between students and teachers [4].

Recognizing the growing importance of soft skills as a complement to technical engineering knowledge [5], this study examines active learning proposals that incorporate community engagement to explore how these approaches contribute to skills development and curricular innovation in this complex institutional context.

The lack of analysis of implemented teaching experiments poses a major problem. Without targeted research on these initiatives, it becomes difficult to understand the factors that facilitate or hinder their implementation. This article aims to fill this gap by analyzing four engineering courses and examining how the integration of active learning and community engagement fosters the development of soft skills. By presenting a variety of experiences, the study highlights the potential of these elements in the design of innovative programs. This work is part of ongoing doctoral research on transformative teaching strategies in engineering education at the Faculty of Engineering (Udelar), conducted by the first author under the supervision of the second author.

For this paper, we have chosen the term "community engagement" based on [6], which identifies it as the term most equivalent to "extensión" in Spanish, the language of Uruguay. As [6] points out, this choice is due to the similarity of their definitions, which emphasize a two-way relationship between university and community, the link to teaching and research, and their use to encompass initiatives such as service learning, community partnerships, and public activities.

By analyzing course syllabi, conducting classroom observations, and interviewing teachers and students, this study aims to identify the essential elements of these courses, explore practical implementation strategies, and highlight strengths and challenges from different angles. The main aim is to provide insight into the design and delivery of engineering courses that incorporate these crucial elements. This understanding is essential to inform and rethink educational policies to better align with the current needs and realities of engineering students, examine how soft skills complement technical knowledge, incorporate community engagement as a curricular activity to make it a relevant part of higher education, and design active learning proposals to implement these aspects effectively.

The structure of the paper is as follows: Section 2 reviews related work and presents the key concepts used as references for the analysis. Section 3 presents the methodology, detailing the objectives, research questions, and instruments used for data collection and analysis. Section 4 presents the results, organized according to the research questions, while Section 5 focuses on their discussion. Finally, Section 6 contains concluding remarks, addressing the study's limitations and offering perspectives for future research.

2 RELATED WORK

2.1 Development of soft skills in engineering

Developing skills beyond technical expertise is gaining increasing significance in engineering programs. Soft skills become crucial in engineering education and highly valued by students, educators, institutions, and employers [5], [7–10].

There are various terms for soft skills—social skills, transversal competencies, social competencies, generic competencies, transferable competencies, basic and life skills, 21st-century skills, key competencies, interpersonal skills, and non-cognitive skills [11]—as well as numerous definitions. As [12] proposes, soft skills "represent a dynamic combination of cognitive and meta-cognitive skills, interpersonal, intellectual, and practical skills."

In engineering, developing complex problem-solving abilities, crafting solutions that consider diverse factors, effectively communicating with various audiences, recognizing ethical responsibilities, creativity, leadership, motivation, and excelling in teamwork are essential [5], [13–16].

According to [7], companies often prioritize candidates with strong soft skills, such as teamwork and relationship-building abilities, over those with superior technical knowledge in the professional field, as they perceive technical skills to be easier to develop than behavioral ones. As [17] highlights, soft skills and hard skills synergy necessitates their integrated instruction. Educators face the challenge of designing courses that develop and incorporate soft skills with technical content and effectively evaluate them. A relevant aspect of soft skills in engineering education is their difficulty being taught and assessed [5]. Therefore, including soft skills proposals in core engineering courses, rather than as separate and complementary training, is essential.

2.2 Promoting soft skills development through active learning

Numerous studies highlight that student-centered teaching methodologies are instrumental in promoting the development of these skills [18–22]. There has been an evolution in addressing soft skills in higher education, accompanied by a growing concern to encourage pedagogical methodologies that promote their development [7], [23].

Active learning, defined as "a student-centered approach to the construction of knowledge focused on activities and strategies that foster higher-order thinking" [24], is implemented in various ways [25–27]. Notably, strategies that flexibly and interconnectedly emphasize effective student participation in the learning process are highlighted for soft skills development [7].

Practice-based and collaboration-oriented methods, such as problem-solving and project-based approaches, are particularly relevant and well-suited to engineering disciplines [28–29]. According to [11], "soft skills learning is "meaningful" as it is willful, intentional, active, conscious, constructive, and socially mediated, involving reciprocal intention-action-reflection activities."

Active learning, mainly when focused on soft skills development, introduces significant complexity. Teachers face challenges not only in the design, implementation, and evaluation of these methodologies [15], [30–31], but also in the effective integration of soft skills across various course types [7]. Active learning approaches in engineering education that emphasize teamwork, real-world problem-solving, and project development through collaboration with community partners or addressing societal issues are particularly effective in fostering soft skills development [32], [33].

In the post-COVID-19 pandemic era, active learning has become increasingly important as universities work to improve in-person educational experiences. During the pandemic, faculty members had to quickly adapt to remote teaching, seeking alternatives to traditional face-to-face instruction. This situation prompted significant efforts to reassess and enhance university teaching strategies—an effort that needs to continue even after the return to in-person learning [34]. As part of this transition, there is a growing emphasis on enriching face-to-face learning experiences and enhancing the value of in-person interactions. Additionally, as noted in [35], engineering educators are increasingly integrating various active learning methods into programs that include community engagement.

2.3 Service-learning: active learning proposals with community engagement as curricular activity

For referring to community engagement as curricular activity, the term most closely aligned with Udelar's concept is [36] definition of service-learning: "a course-based, credit-bearing educational experience in which students (a) participate in an organized service activity that meets identified community needs and (b) reflect on the service activity in such a way as to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility." At Udelar, this concept emphasizes the university's commitment to societal engagement and problem-solving, linking academic knowledge with community wisdom to produce new, socially relevant knowledge. This approach fosters collective, horizontal, and transformative learning environments by integrating mutual, situated, and active learning with community contexts to address real challenges and improve living and working conditions [3].

Service-learning is crucial for addressing current challenges in engineering education by providing practical learning and real-world contexts and enhancements to problem-solving and critical thinking. Essential characteristics include advancing learning goals and community purposes, reciprocal collaboration, and critical reflection for meaningful outcomes [37].

Service-learning has also gained significance in the post-pandemic era, offering students meaningful opportunities to engage with real-world challenges and develop essential skills for navigating an increasingly complex and uncertain global landscape [38]. Furthermore, it plays a crucial role in motivating students' return to the classroom while fostering deeper in-person collaboration and engagement.

Service-learning approaches vary widely, from short-term modules to long-term projects across different academic levels and subjects, effectively promoting teamwork, real-world problem-solving, and soft skills development through community interaction [32], [39–42]. In [43], a three-phased model for service-learning course design is proposed, aiding the development of courses that progressively increase complexity and responsibility; typical stages that service-learning projects include for students are described in [44].

The literature review [45] showed that service learning effectively develops students' interpersonal skills, particularly in the social, methodological, and personal domains. Among others, [46] indicates that service-learning motivates engineering students to participate in more service opportunities, pursue service-oriented careers, and integrate their service attitudes into engineering. However, service learning has risks and benefits and presents challenges such as academic, social, and individual difficulties [47], [48].

As [49] points out, community engagement actions can enrich and transform university educational processes and open up new research perspectives when approached from an integral perspective. These authors note that such integration poses challenges in terms of teaching roles, program organization, assessment, theory-practice relations, and institutional transformation by deepening the dialogue between university and society. Similar issues are addressed by other authors, including [40], [45], [50]. Logistical constraints, cultural barriers, and disconnection issues are significant obstacles to the success of engineering community engagement programs [40]. Research findings also reveal a lack of clarity in service-learning programs regarding community work and the specifics of community partnerships [51], [52].

3 METHODOLOGY

Four elective courses, C1 to C4, were selected to analyze how active learning and community engagement in service-learning proposals promote soft skills development. The selection was based on consultations with degree and institute directors as part of a broader doctoral research study on active learning at the Faculty of Engineering (Udelar). Within the scope of this research, these courses stood out as the only ones incorporating service-learning among all reviewed active learning courses.

These courses, summarized in Table 1, vary in academic stage, discipline content, and community engagement approaches but share common features such as elective status, medium workload, and mandatory in-person attendance for small student groups.

This study focuses on a small, purposively selected sample of four courses, chosen to represent a diverse range of service-learning proposals in engineering. It aims to identify the main learning objectives, characterize crucial elements of the proposals and their implementation, determine the soft skills targeted for development, and synthesize the strengths and challenges highlighted by teachers, students, and classroom observations. By doing so, it seeks to provide a meaningful understanding of the specific contexts, methodologies, and outcomes of these courses, offering insights and inspiration for similar initiatives in engineering education while acknowledging the contextual nature of the findings.

The research questions (RQ) guiding the analysis are:

RQ1: What are the main learning objectives of the proposed courses?
RQ2: What are the key characteristics of the proposed courses?
RQ3: Which soft skills are targeted for development through the proposed courses?

Table 1. General characteristics of each course

	C1	C2	C3	C4
Career Stage	Beginning	Mid	Mid-to-late	Mid-to-late
Engineering Programs	Computer	Civil, Mechanical, Production	Computer, Electric, Civil, Chemistry	Civil
Multidisciplinary approach*	No	Yes Music school	Yes Architecture and Design School	No
Core discipline content	Robotics	Environmental Pollution	Innovation & Creativity	Construction & Civil Engineering
Community partners*	Primary & Secondary Schools	Municipal Orchestra of Montevideo	Small Enterprises (Industrial Technology Municipal Park)	Youth Center
Hours/week dedication	6	4	8	6
No. Student*	17	13	16	5

Note: *For the analyzed edition of each course.

Qualitative data was collected during the second term of 2022 and the first term of 2023. This process included a review of the syllabus, non-participant classroom observations, and interviews with each course's responsible teacher and students who participated in the observed sessions. Table 2 details the number of classroom observations and interviews conducted.

Syllabi review aimed to identify each course's learning objectives, content, methodology, and learning assessment methods. This review focuses on identifying relevant elements before selecting analysis courses and guides for conducting classroom observations. Moreover, [51] and [52] were used to identify relevant elements in the service-learning proposal syllabi.

Classroom observations, non-participant, were conducted to examine how the syllabi proposals were implemented in practice. With authorization from the course teachers, three to four sessions were observed per course at different points in the semester to capture a range of instructional strategies. Based on [53] and [54], the semi-structured guide focused on several dimensions: teaching methods and pedagogical strategies, active and collaborative learning, student-teacher interactions, assessment, and cognitive challenge. Given the service-learning context, community engagement was analyzed within these dimensions, mainly how students interacted with community partners and integrated community engagement into their projects and reflections. The following works guided the identification and categorization of relevant elements in the classroom observations: [27] for active learning, [43] for community engagement, and [7] and [45] for soft skills and service-learning.

Student interviews were conducted at the end of the term using a semi-structured guide and based on voluntary participation. Requests were made via each course's Moodle platform. The interviews focused on characterizing the course, highlighting positive and negative aspects, identifying main learnings and challenges, and exploring how students valued the development of soft skills and their work with community partners. Additionally, the aim was to determine consistency between the classroom observations and the students' feedback.

Teacher interviews were conducted with the responsible teachers of each course after the term ended, using a semi-structured guide. The interviews explored three main areas: teacher involvement in the proposal's development, their perspectives on student participation and the challenges faced in implementation, and their role and interaction with students. All responsible teachers participated in the interviews.

Table 2. Number of classroom observations and interviews conducted

	C1	C2	C3	C4	Total
No. Classroom observations conducted	3	3	4	4	14
No. Student*	17	13	16	5	51
No. Engineering Students*	17	8	4	5	34
No. Interviewed Engineering Student	4	7	3	5	19
No. Interviewed Responsible Teacher	1	1	1	1	4

Note: *For the analyzed edition of each course.

Before conducting the interviews, students and teachers received an informed consent form explaining the study's scope, use of results, and assurances of confidentiality and anonymity for students. Teachers were informed that they might be identifiable by their courses. Each interview began with a recorded confirmation of participants' voluntary agreement to the consent terms.

The interview quotes, originally in Spanish, have been translated into English for this article. Every effort was made to preserve the original expressions and the characteristics of spoken language in the translation. Interview quotations are coded according to the course identification number, whether the interviewee is a teacher or a student, and, in the case of students, a number explicitly assigned to each course. Teachers are not assigned a number since only one teacher is interviewed per course. For instance, "(C1-T)" refers to a quote from the teacher responsible for course C1, while "(C2-S3)" indicates a quote from student 3 of course C2.

Data triangulation was employed, incorporating inputs from syllabi reviews, classroom observations, student interviews, and teacher interviews. MAXQDA software [55] was used for systematic organization, categorization, and data analysis. The AIs used were ChatGPT to support translating the text from Spanish to English and Grammarly for proofreading and style corrections in English.

4 MAIN RESULTS

The four courses in which service-learning proposals were implemented share common characteristics. Triangulation of data sources revealed consistency between program reviews, classroom observations, and interviews with students and teachers. The results of the primary analysis of C1 and C3 were presented in [56]. The results are organized according to each RQ.

4.1 RQ1: What are the main learning objectives of the proposed courses?

Reviewing the syllabus of each course reveals that they share common goals. Across courses, there is a strong emphasis on fostering community engagement and enhancing students' soft skills. These courses aim to prepare students to collaborate effectively within teams—in two cases multidisciplinary—engage with diverse socio-economic actors, and address real-world challenges. As [51] points out, service-learning proposals include both content-centered learning objectives and learner-centered objectives.

By integrating robotics into educational settings (C1), applying environmental engineering concepts to community-related issues (C2), promoting creativity and entrepreneurial thinking (C3), and involving students in hands-on civil engineering activities with community youth centers (C4), these courses collectively encourage students to develop essential soft skills such as teamwork, communication, problem-solving, and leadership. Students are encouraged to identify community needs and enhance problem-solving, critical thinking, and social responsibility.

The syllabi of each course incorporate elements that [36] and [37] identify as characteristics of service-learning and align with [52]'s description of service-learning as an approach that combines academic work with community service. This integration is evident in the learning outcomes, which include developing critical thinking skills, connecting theory with practice, collaborating with community partners, and enhancing communication and leadership skills. All courses establish prerequisites for enrollment to ensure that students have a minimum foundational knowledge in areas such as programming, construction, environmental science, or advanced coursework in their degree, enabling the development of the course proposals within these goals.

In interviews, instructors also emphasize these as the primary learning objectives. All highlight teamwork and interaction with community partners, underscoring communication and its associated skills. In the words of the instructors: "*Teamwork, I believe, is fundamental (...) and the connection with the community gives you a reality shock*" (C3-T);

"*...for many engineering students,* (...) *I tend to believe they have a certain socio-economic profile. And many of them, many of us, lack contact with many of the realities that are happening. And it's good for them to see and step out of the south of Av. Italia* [their usual place of residence]" (C4-T);

"*...an immersion activity where students lead the project on site*" (C1-T);

The problem we tackled involved, on one hand, acoustics concepts (...) And that was the thematic line. And the other line, the expression line (...) In general, they learn to improve their skills to make an understandable PowerPoint, to make a presentation, to speak clearly, to address the people they are talking to. And, well, of course, both things come together (C2-T).

In summary, the four courses share a strong focus on fostering soft skills and community engagement, aligning with service-learning principles. All emphasize teamwork, communication, and critical thinking, with multidisciplinary collaboration highlighted in two cases. Common objectives include equipping students to tackle real-world challenges through hands-on projects that integrate academic knowledge with community service. Key differences lie in their specific engineering applications and disciplinary contexts, shaping the nature of community interactions and the soft skills targeted. This diversity highlights the flexibility of service-learning in developing soft skills while ensuring relevance to distinct engineering fields.

4.2 RQ2: What are the key characteristics of the proposed courses?

The classroom observations and interviews revealed that the course proposals were consistently implemented as stated in the syllabi. They highlighted shared teaching methodologies and pedagogical strategies across all courses, confirming their alignment with active learning and community engagement proposals. These strategies include project-based learning with community partners, engaging with real-world problems, direct on-site interaction with non-university actors, collaborative learning in small groups with fixed teams outside the classroom, classroom activities prioritizing student engagement over traditional lectures, and formative assessments.

As [45] indicates, these proposals follow the most common model of service-learning, the top-down approach, where courses offer a pre-structured project in collaboration with a community partner. In all courses, students engage in pre-structured service activities refined through collaboration between teaching teams and community stakeholders, ensuring alignment with course content, specific skills, and academic schedules.

Each course implemented these elements uniquely, offering varied depths and approaches to executing service-learning proposals. The main characteristics of each course are outlined as follows.

Development stage. C4 is in its inaugural edition and is led by a single instructor. At the same time, the other courses have more established frameworks involving at least two teachers, allowing them to evolve teaching strategies and course design over time. The interviews highlight diverse approaches to course adaptation and enrichment, especially in C2 and C3, which have demonstrated flexibility and adaptability by collaborating with different community partners in each edition and engaging with multiple stakeholders.

Funding structure. C1 benefits from dedicated community engagement funds that, although not fully consolidated, are consistently renewed yearly, providing a stable financial base. In contrast, C2 and C4 are sustained by faculty who incorporate these activities into their regular teaching duties, reflecting their broader responsibilities as full-time staff expected to engage in various functions, including community engagement. C3, however, faces considerable challenges due to unstable funding, which puts its continuation at risk annually, resulting in the course not being offered in 2024. Since these courses are elective and offered alongside many others, their inclusion or exclusion does not affect the administrative structure of the curriculum.

Project duration and complexity. These elements have a variety, as reported in [42]. C1 spans half a semester, C2 and C3 extend an entire semester, while C4 goes beyond a single semester, overlapping academic terms. Regarding complexity, the projects in C1 and C4 focus on implementing activities within the community, particularly in educational centers. Rather than solving community problems, these projects are designed to engage the community and students in activities of mutual interest, emphasizing engineering content and relevant soft skills: *They* [youth center] *lacked workshops related to the technological side* (C4-T);

we needed to respond to the demand from the educational centers that asked us for things to work with [robotics]. *And also to support, we know there are a lot of kits and robotic equipment in the educational centers that aren't being used* (C1-T).

C2 and C3 projects have a broader scope, focusing on generating solutions or proposing ideas for community-identified problems: *So they presented us the problem of how we could help the band* [orchestra] *sound better in open spaces. And that was the problem we tackled* (C2-T). These courses involve students at least midway through their studies, incorporating more advanced engineering knowledge and setting higher expectations for students and community partners. C4, while similar in scope to C1, involves mid-to-late career students, yet it is their first service-learning experience.

Project stages. The project proposals align with the five service-learning stages outlined by [44]: inventory and investigation, preparation and planning, action, reflection, and demonstration, with each course emphasizing different stages as needed. In C2 and C3, the initial investigation stage is pivotal, employing tools such as interviews, surveys, and direct observations to document community needs. Preparation in all courses focuses on group organization, task distribution, deadlines, and overall strategy. The action stage varies significantly between courses, from implementing activities in C1 and C4 to presenting prototypes as solutions to the problems addressed in C2 and C3. Reflection is integrated throughout all courses, with final reflective exercises at the end of the term and additional opportunities for reflection strategically placed at various course points. The recommendation of [42] to incorporate more elements to enhance reflection further has yet to be widely identified in the courses. All courses require a demonstration stage, typically in the form of final documentation and oral presentations.

Interaction with community. It was identified that all the courses follow one of the possible approaches, direct service-learning [42], [43], which involves interaction between students and community partners. However, they vary in terms of the level of preparation and structure in their implementation. In C2, C3, and C4, initial interactions are guided by instructors. However, their involvement decreases as the course progresses: *...they grow over the course and eventually engage in direct, peer-level dialogue with the external* [community] *actor. The actor presents their problem, and the students avoid technical jargon, striving to understand. (...) We always tell them there's no shame in not knowing or making mistakes; what's important is trying to understand them (...) It's about achieving that exchange, making it flow (...) but then they go on their own and do it all by themselves, and I don't even need to be there* (C2-T). C1 is the only course where students independently manage their initial contact, selecting an educational center from available options and directly coordinating activities within predefined boundaries. C2 and C3 feature the most complex interactions, with students discussing specific issues and potential solutions. In C4, students take on comprehensive project management, from activity design to securing resources and coordinating logistics.

For C3 and C4, classroom observations of group work with community partners outside the classroom were possible. In both, a positive climate was evident, created by both parties. Notably, the responsibility and challenge this posed for engineering students were clear, as was the support from instructors who were present but did not dominate the space. The experiences differed significantly. In C3, the exchange was more challenging, as it marked the first encounter between each group and their community partner. In that instance, they were introduced to the problem they would work on. In C4, where the activity involved a workshop on bridge construction that included a group challenge using non-traditional materials, the focus was more on sharing experiences and fostering interest and engagement in engineering with Faculty of Engineering (Udelar) students and the youth participants at the center. None of the courses included explicit opportunities for interaction between students and community partners focused on reflecting on the process, learning outcomes, and contributions from each side. These elements are crucial in service-learning, as highlighted by several authors, including [42].

Specific content approach. The academic content approach in each course varies, showcasing different service-learning options, stating one of service-learning's key strengths: its flexibility to adapt across a wide range of courses that address diverse disciplines and subjects, as noted by various authors, including [40]. In C1, aimed at early-career students, the first half focuses on specific robotics content to be applied in the project in the second half. In the other courses, content is integrated as the project develops from the start of the semester. Here, students are further in their studies, and the courses aim to apply previously learned content. In C2 and C4, elements are addressed as they arise. For example, concrete work leads to lab tests before proposing activities at a youth center; sound data analysis involves in-class discussions and improvements based on instructor feedback: *The activity one ended up being the construction of concrete elements*. (…) *we conducted two tests in our lab* (…) *and then we went to the site to conduct the workshop* (C4-T). In C2, the approach has evolved throughout editions to reach the current proposal: …*at the beginning, we used to teach more theory. Now, we try to have them study the topics themselves because we see that it works better among them. So, we develop a theoretical framework together. We contribute additional aspects as we go along. We also determine what kind of experimental work needs to be done, and whenever possible, we do it* (C2-T). In C3, which focuses on design and creativity, the course is pre-structured weekly to introduce specific content necessary for each project stage. This course uniquely includes an asynchronous weekly virtual session, where theoretical material is presented and then applied during the subsequent in-person class. All courses require deepening, focusing, and tailoring specific tasks for each project, coordinating work accordingly.

Classroom activities. Classroom environments across the courses vary significantly, ranging from traditional classrooms to laboratories and diverse community spaces. While each course prioritizes direct interaction, teamwork, and minimal lecturing, the approach to these activities differs substantially. Structured classroom activities are planned to support the different stages of community engagement, guiding students through the preparation, execution, and analysis of their projects. One student remarked, *I think the course is really interesting, not so much for the subject matter (…), but for the methodology. It's quite interactive, allowing us to talk with our peers, because in many of the courses I took this semester, I barely knew anyone. You go to the class, have the session, and that's it* (C2-S4). Another student noted, *For engineers especially, it pushes us out of our comfort zone, from just going to class, listening to what the professor says, and doing things on our own. Here, we always have to participate in class, and it's something different, something we're not really used to* (C3-S2). Classroom observations, consistent with interview findings, reveal classroom spaces aligned with active learning approaches as described by [24] and [27].

In C1, the first half of the course follows a traditional format with lectures, practicals, and labs. As noted by the instructor, this structure is standard for many courses: *A reasonable amount of theory associated with practical work. (…) And when they accumulate sufficient knowledge, we introduce them to the lab. (…) All our courses have historically followed this model* (C1-T). The course shifts in the second half, focusing more on hands-on lab work within community interaction. During this phase, students work in groups to design activities, solve practical problems, and test equipment, all while receiving tailored guidance from the instructor. This phase is less structured, with no specific agenda; instead, it evolves based on students' needs and challenges encountered during their projects.

C4 deviates from traditional weekly class schedules. Instead, meetings between students and instructors are arranged according to project needs, focusing on planning, management, and role assignment. These sessions are highly student-centered, with the instructor facilitating and guiding as necessary. The course activities, implemented in collaboration with the youth center, include practical workshops on concrete bench making and bridge construction using unconventional materials. These activities are designed to be hands-on and collaborative, emphasizing student initiative and responsibility. One student reflected on this approach, saying, *The activity* *carries a different kind of responsibility (…) I never felt pressured by* [the teacher] (…) *it's great how they were like, 'Don't worry, we'll get it done,' rather than 'You have to do it,' but more like 'Let's do it together'* (C4-S2).

In C2 and C3, classroom activities are designed with specific objectives to address the projects' core content and the soft skills required. C3 follows a consistent structure throughout the semester, beginning with a warm-up, then a brief theoretical segment, and then workshop-style activities. As described by the instructor: *The dynamic we use in class starts with a warm-up to clear the mind of outside distractions. Then we typically have a short theoretical session of 15–20 minutes to explain the day's activities. After that, we work in a workshop format, sometimes in groups, other times with instructors circulating among tables, depending on the stage and dynamics. At the end, we close with a summary of what was done and what needs to be done in the coming week* (C3-T). Classroom observations confirmed the variety of activities in C3, demonstrating the instructor's experience and the positive impact on active class participation. The weekly planning ensures a continuous flow of specific content and tools for the upcoming community engagement stages. The course also benefits from a well-coordinated teaching team, where roles are clearly defined, and complementary contributions enhance the learning experience. In C2, specific classroom activities are also included, but with a more flexible approach, adjusting weekly to address the immediate needs of the students and the project.

Student enrollment. All four analyzed courses have a low student count, ranging from 5 to 17, which provides an excellent student-to-teacher ratio conducive to active learning activities. This smaller class size stands for the typically larger cohorts at the Faculty of Engineering (Udelar) and is more comparable to the elective courses offered later in the programs. While each course sets a maximum enrollment cap to ensure the feasibility of active learning proposals, this limit has not been a concern as the actual numbers remain well below the threshold. For example, in C1, student participation has been consistently steady without much effort: *It usually reaches a reasonable cap without major efforts and has remained stable at 20* (C1-T). However, achieving the minimum enrollment has proven more challenging in other cases. In C4, for example, considerable effort was required to attract students: *It took quite a bit of effort to get students to join; it's not easy. (…) There's not a broad demand from engineering students to participate in this model* (C4-T). Due to low enrollment, C2 is not offered every semester: *Many times, the course doesn't form, and we also don't offer it every semester. Now, we're only going to offer it in the even semester* (C2-T). Furthermore, in C3, participation from engineering students is notably lower than from other faculties; in one observed edition, only 4 out of 17 students were from engineering.

A contributing factor to these enrollment challenges is the absence of a service-learning credit requirement in Faculty of Engineering (Udelar) degree programs. Service-learning courses are positioned alongside a wide array of elective options. Some of these alternatives have set credit requirements, making them more appealing to students seeking to fulfill specific academic obligations. Consequently, service-learning courses must compete for student attention. Research by [47] supports the finding that engineering students tend not to prioritize service-learning courses, with the top reasons for participating being availability of free time, joining with friends, or receiving extra points towards their academic performance. Furthermore, students recognize that participation in community engagement projects is voluntary, and they prefer to engage in such activities outside regular class hours to avoid sacrificing instructional time.

Teamwork. Teamwork is a central soft skill highlighted in the syllabi and observed in classes and interviews with students and instructors. This relevance of teamwork is consistent with the literature [11], [17]. In all courses, priority was given to teamwork, and much time was dedicated to team interaction. Different approaches to teamwork are observed: in C1 and C3, each group of three to five members works independently with different community partners, while in C2 and C4, the class group is linked to a single community partner and subdivided according to the activities to be carried out.

The multidisciplinary collaboration in C2 and C3 involves students from different faculties and fields, which adds a valuable dimension for teachers and students. This aspect is highly valued and often emphasized as a standout feature in interviews. *Teamwork (…) first among engineering students, from different engineering fields, is already good. And with design students, for me (…) it's a natural bond and it's great. They have different, complementary points of view and so on. And when they start working on a common goal, for me both are empowered. The designer is empowered, and the engineer is empowered because he sees another point of view, other perspectives. We have totally different languages, don't we? What is a prototype, what is a model. Well, and with those of architecture as well. So, it's great when they join* (C3-T). From the student's perspective, the experience was described as exciting and enriching: *Something that really caught my attention was how all my group members are from design, and they all approach things in the same way. They always try to meticulously perfect everything, whereas we* [engineering students] *tend to just throw everything onto a sheet or report and then fix it as we go. It's interesting because you slowly learn from them and their way of thinking about things* (C3-S2). As noted in [40], the rise of multidisciplinary service-learning proposals in engineering education highlights a growing trend of fostering collaboration between engineering students and those from other academic disciplines. This multidisciplinary approach reflects an increasing recognition among universities and faculty of the value of integrating diverse fields, which enriches the educational experience and enhances the impact of community-focused projects by bringing a broader range of perspectives and expertise to real-world problem-solving.

Teacher's role and student-teacher interaction. In all courses, classroom observations indicate that teachers emphasize direct interaction with students, guiding the learning process and fostering a positive classroom environment. This observed teaching role aligns with the expectations for active learning approaches in general [27], specifically for service-learning proposals [42].

The classroom climate emphasizes friendly interaction, active participation, and support, leading to a close relationship between students and teachers. What was observed was consistent with the feedback of teachers and students in the interviews: *we create a much closer bond than in a regular class. You see them one-on-one; you have a WhatsApp group (…) and you start developing another kind of bond, more of camaraderie, I don't know what to call it. But of course, every week we meet, we go together, you have to share the car, share workshop sessions that last two or three hours, you're sharing much more week to week, so naturally, especially in relaxed environments, where there isn't a presenter, I don't have the role of 'I am the one who knows, and you are the ones learning' (…) so yeah, the bond with them ends up being really good* (C4-T). From the students' perspective, they expressed appreciation for the closeness of the teachers and the different roles they played: *It was also nice that she said* [the teacher] *'I don't know, I'm actually exploring this with you,' even though she obviously had more experience and gave us more information, it was nice to investigate together, not from a position of authority, but more collaboratively, which I think is beneficial for both teachers and students* (C2-S1). Additionally, another student noted, *…the teacher's role was different, more approachable, more on equal footing, which also allowed us* *to express ourselves differently and with more freedom depending on how the teacher positioned himself… so it felt like there was more freedom* (C4-S2).

These elements are aligned with [20] reference to significant positive relationships between project-based learning activities, student perceptions of classroom climate, and student motivations. In summary, teachers create opportunities for developing competencies, strategies, and skills, which, in turn, promote student interaction. It was possible to observe different teaching strategies of explanation and facilitation, which were suggested to favor active learning, as reported by [30]. However, the level of teaching support varies between courses, particularly in preparing students for community interactions. This aspect reflects one of the challenges of the teaching role in these active learning proposals, which literature emphasizes and provides guidance on, particularly for developing soft skills [12]. In C1, teachers do not accompany students in their community interactions: *we don't accompany them (…) I would have liked to, but (…) we didn't have the physical time to go* (C1-T). In contrast, in C2 and C3, teachers provide more guidance by accompanying students during their initial interactions with the community, offering support and structure, particularly at the beginning. These courses also incorporate specific activities to prepare students for community interactions, enhancing their soft skills and understanding of core content. This structured approach is less pronounced in C1 and C4, where preparatory activities are not prominent. This difference may be linked to the varying professional experience and levels of community engagement among instructors. Teachers of C2 and C3 possess extensive community engagement experience, reflected in their practical implementations and long-standing teacher careers at Udelar. Conversely, though younger, the teacher of C1 has several course editions of experience, while C4 marks the teacher's first solo community engagement proposal.

Formative assessment. Common elements for assessing learning across the four courses align with [41] for service-learning proposals. These include a final written report and an oral defense, where, in all courses, students are expected to demonstrate their learning process and reflect on their community engagement and experiences. Regular student-teacher exchanges throughout the semester support this process, as evidenced in interviews and classroom observations. Teachers emphasize that the evaluation focuses on the process: *We encourage projects and ideas to be innovative and disruptive. (…) They might reach a point where they say, 'No, I made a mistake.' But you learned the process of doing it, you learned how to do it. So, maybe the result in some cases isn't ideal, but that doesn't affect us. (…) I can't punish you for making a mistake. The only thing that's not acceptable is not working, not putting in effort (…) But if you followed the process, you did it, and so on, the result is just one part of what we evaluate. If the result is good, great. If not, it's not decisive (…) This is one of the few courses that encourages taking risks and doesn't punish you for mistakes. That's also an important shift in mindset* (C3-T). Students in all courses agree that the work process is evaluated: *At least, one of the reasons I enrolled was precisely because there were no exams, no final test, no midterms. Honestly, at this point in my studies, I feel completely fed up with exams, and I increasingly feel that they are the least effective way of assessment. I believe this method is one of the most effective because it helps you go through a process, create something with the concepts you've learned, and ultimately arrive at something concrete, or if not concrete, at least something based on what you've learned. I think it's good; I believe it should be applied more in other courses* (C3-S2).

Regarding the specific disciplinary content of each course, there are differences in their assessment methods. In C1, evaluations are based on individual exercise submissions and a final oral defense. In C1, C2, and C3, the final defense includes elements of core disciplinary content. In C2, the defense serves as the course exam. C2 and C3 incorporate self-evaluation and peer assessment, evaluating involvement, participation, and collaboration. Additionally, C3 holds a collective evaluation session after the oral presentations. In C4, the course concludes with a final meeting where students and the teacher discuss their experiences and suggest improvements for future editions.

Reflection is present in all courses but appears to need more structured guidance from the teacher, and it often focuses more on narration than on analyzing underlying causes. Classroom observations of the closing sessions confirmed students' commitment and intrinsic motivation through their presentations, echoing interview sentiments. However, also consistent with [41], community partners do not participate in the final presentation, nor is there a joint evaluation involving students, teachers, and community partners. Instead, students receive feedback exclusively from the teaching team. Only in C1 is community feedback solicited through a survey after the course; according to the teacher, the responses are generally positive, as mentioned during the interview.

In summary, the courses share commonalities and differences in classroom activities, interaction, and formative assessment. All four prioritize direct interaction among students, teachers, and the community, emphasizing teamwork and an active, reflective approach. Teaching strategies focus on guiding learning processes and fostering a participatory, very close-knit climate. Additionally, all courses base evaluation on the learning process rather than outcomes, encouraging risk-taking and experiential learning. Key differences emerge within these shared aspects. Classroom activities in C1 and C3 follow a more defined and structured progression, while C2 and C4 adopt flexible approaches tailored to project needs. Regarding community interaction, teachers in C2, C3, and C4 actively accompany students during their initial engagements, whereas this guidance is less prominent in C1. Multidisciplinarity distinguishes C2 and C3, involving students from diverse fields and enriching project perspectives and solutions. Regarding formative assessment, although all courses include it and emphasize its process-oriented nature, the specific elements they incorporate vary widely. These variations reflect how pedagogical practices are adapted to align with the objectives, resources, and specific approaches of each educational proposal.

4.3 RQ3: Which soft skills are targeted for development through the proposed courses?

The development of soft skills is central in all four courses, as consistently reflected in syllabi, classroom observations, and interviews with students and faculty. Core soft skills, like teamwork, communication, problem-solving, autonomy, and empathy, are particularly evident during interactions with community partners. These skills align closely with the classification outlined by [7], which includes effective communication, interpersonal trust, cooperation, empathy, critical thinking, decision-making, and self-assessment. This congruence between the observed soft skills and the broader classification emphasizes how the courses successfully foster these essential skills through community engagement, supporting the overall educational objectives in engineering.

Student feedback notably highlights the crucial role of active learning activities and direct community engagement in fostering soft skills development, with highly positive evaluations, in line with findings from [8] and [10]. These insights often emerged spontaneously during interviews, without specific questions about soft skills, suggesting that the courses significantly impacted these competencies. Many students reported considerable improvements in teamwork, communication, problem-solving, and leadership—skills developed through facing real-world challenges that required them to apply their knowledge in practical contexts. This connection between skill enhancement and community engagement aligns with the benefits of service-learning for soft skills development, as highlighted by [45], and underscores how real-world applications in service-learning effectively support the growth of essential soft skills in engineering education.

Additionally, many students expressed a sense of accomplishment from their contributions to meaningful community projects. This experience heightened their social responsibility and reinforced their commitment to applying their engineering expertise for societal benefit. Such engagement aligns with the broader objectives of community engagement at the Faculty of Engineering (Udelar), which aims to strengthen the relationship between engineering and community needs. Table 3 presents a synthesis of students' quotes from interviews illustrating the development of each specific soft skill.

Table 3. Illustrative quotes from student interviews about soft skills development

Soft Skill	Student´s Quotes
Communication	*…being able to interact not only with classmates but also with people from outside, with the interviews we conducted and so on, that's what I personally liked the most. It's great to step out of what we always do, and I think it's necessary, not just for when we graduate but for life in general* (…) *You talk to people, communicate, and sometimes you have to either debate, argue that you're right, or defend yourself in some way, which we don't do much of in college.* (C2-S5)
Problem-solving, Decision making & Autonomy	*you design it, you decide, and also, I mean, this is one of the few* [courses] *where you have decision-making power over something real that's happening, something that's actually getting done. You get to decide, let's do this or make things difficult for ourselves, or take the easy route, and you have that freedom.* (C4-S4)
Teamwork	*It's like a very collaborative workshop with many instances where you need to debate and think as a team, and it allows you to approach problems differently, which might not be the usual ones we encounter.* (C3-S2)
Empathy & Contribution	*The motivation was to help, not just to solve a problem, but to think, 'I can be useful and help someone with something more concrete', not just a problem we're more used to that's more fictional. Saying, 'Wow, this is about people's health', I feel that was motivating because it was like, 'Wow, how cool that we can contribute something', maybe it's not much, but I think that was the most motivating part beyond the particular topic.* (C2-S1)

C2 and C3 stand out for their structured approach in applying soft skills and explicitly teaching them through well-planned activities, as observed in the classroom observations and confirmed in interviews with teachers and students. One teacher highlight's: *The two highest points I think we had (…) was the six hats workshop (…) and in the expression part we took a card game*" (C2-T). Students also shared their experiences: "*…as if she* [the teacher] *gives us the tools, for example, the six hats. I think it made the debate much more bearable, because if you put yourself in a group of six and start debating, I don't know, it's much more difficult, I think, it added dynamics to the debate and she* [the teacher] *came and participated in a game* (C2-S3); *…at the beginning I didn't have much confidence in the hats because I thought that the idea works in itself but I thought that we weren't going to get anywhere (…) but in a short time we* *reached many, and we exchanged in the groups and we mixed ideas and we got different things, it's great* (C2-S5).

In summary, the development of interpersonal skills is fundamental in all courses, focusing on teamwork, communication, problem-solving and empathy, especially through community engagement. Students highlight significant improvements and a greater sense of social responsibility, linking their engineering knowledge to meaningful contributions. The structured approaches in C2 and C3 show intentional strategies for the development of soft skills.

5 DISCUSSION

This study aimed to identify the most significant elements of four engineering courses from the Faculty of Engineering (Udelar), which integrate active learning, community engagement, and soft skills into their design and implementation. The analysis focused on understanding the main learning objectives (RQ1), characterizing key elements of each proposal (RQ2), and identifying the intended soft skills outcomes (RQ3). The qualitative approach involving syllabi reviews, classroom observations, and interviews with teachers and students allowed for a comprehensive examination of these aspects.

The findings highlight strengths and challenges in integrating active learning and community engagement within the service-learning framework and fostering soft skills development. This methodology provided a well-rounded analysis, offering insights into areas for further improvement. The study highlights the potential of service-learning proposals to contribute to engineering education by blending technical expertise with community-based experiential learning. The following discussion will outline the primary strengths and challenges identified.

5.1 Main strengths identified

The main strengths identified align with findings in the relevant literature and relate to integrating active learning and community engagement through flexible service-learning course designs, promoting student-centered learning, developing soft skills, connecting real-world applications and enhanced student engagement, and using continuous, process-centered assessment. These aspects are discussed as follows.

The four courses analyzed integrate active learning and community engagement across core content areas and community contexts, demonstrating service-learning's flexibility to adapt to diverse engineering disciplines. This adaptability enables the incorporation of real-world problems and community engagement within the curriculum, even in courses with limited time commitments, showing their feasibility in varied educational settings. The literature highlights this aspect [42].

According to the [27] framework, these courses align with student-centered learning, emphasizing active student engagement and moving away from traditional lectures. Classroom observations and instructor interviews reveal dynamic environments where students participate in discussions, teamwork, and community projects. This approach supports the development of autonomy, self-regulation, critical thinking, and problem-solving skills. The combination of technical knowledge with soft skills further enhances the educational process by fostering holistic learning.

When analyzed using the three-phased model [43], the courses exhibit characteristics from all three phases, with some expected overlap between them: exposure, capacity building, and responsibility. Most courses align with Phase II (Capacity Building), focusing on increasing student responsibility and reflective thinking. Some aspects go deeper and approach Phase III (Responsibility), particularly in instances of on-site engagement with community partners. The variability in teaching roles, from direct management to advisory positions, helps accommodate student development at different stages, further supporting the progressive increase in student responsibility and reflection.

The learning objectives identified through the syllabi review, consistent with the classroom observations and interviews, are characteristic of service-learning proposals as outlined by [51] and [52]. They incorporate crucial elements of service-learning as described in [36] and [37]. All instruments highlight the importance of soft skills in these proposals, confirming that soft skills development is integral to the course design. An explicit integration between discipline-specific content and community engagement is evident, with both areas being assessed.

These courses serve as examples of effective incorporation of soft skills alongside technical content, a practice recommended in the literature for its role in solidifying soft skills development, as noted in [17]. This approach aligns with Udelar's proposals on community engagement as a curricular activity [2]. Students value the opportunity to develop skills often underrepresented in traditional engineering curricula, such as teamwork, communication, and leadership. Integrating community engagement and active learning within the service-learning framework creates a comprehensive educational experience, blending technical expertise with essential interpersonal competencies. Additionally, students appreciate these courses' flexibility, freedom, and innovative evaluation methods.

Another key strength is the courses' focus on practical applications, which connect theoretical knowledge with real-world challenges. Students report higher motivation in solving real-world problems that require technical and soft skills, consistent with [32] and [33].

A consistently observed strength across the four courses is the creation of a positive classroom climate characterized by high levels of student engagement. Both students and faculty emphasize the practical relevance of the courses, particularly in addressing real-world community problems. This supportive climate is driven mainly by the enthusiasm and commitment of the faculty, which plays a central role in maintaining student interest and fostering a conducive learning environment. According to [20], students tend to show strong motivation based on personal values and interests when engaged in project-oriented activities. Moreover, a positive correlation exists between their perception of a supportive classroom climate and their intrinsic motivation. It highlights the importance of fostering an environment where students feel autonomous and engaged in successful student-centered learning experiences.

The emphasis on formative assessment, which prioritizes the learning process, is well-received by teachers and students. Continuous feedback encourages reflection, self-regulation, and ongoing improvement throughout the courses. This process-centered approach helps cultivate a growth mindset and supports lifelong learning.

Evaluation does not emerge as a specific challenge for the instructors; students express positive feedback. These courses have successfully integrated formative assessment despite being recognized as a common challenge in other service-learning contexts, as noted by [5]. This success may be attributed to these courses being electives rather than core requirements, allowing for greater flexibility in evaluation methods. Furthermore, the lower student count enables more individualized attention, enhancing the effectiveness of feedback and personalized assessment.

5.2 Main challenges identified

Despite the courses' strengths, several key challenges have been identified, requiring attention to enhance the overall service-learning experience: low student participation and institutional support, lack of coordination and integration with other educational experiences, and limited opportunities for reflection and feedback from community partners. These challenges are further discussed next.

While students who enroll are highly engaged, overall participation still needs to improve, suggesting gaps in course promotion and alignment with student needs, as these courses are electives and not part of a mandatory sequence. The sustainability of these proposals relies heavily on individual faculty commitment rather than solid institutional policies. Despite institutional efforts to incorporate community engagement into curricula, challenges persist in scaling and embedding these courses into the broader academic program. These elements are highlighted as challenges for the inclusion of community engagement as a curricular activity by [49].

Each course operates independently, lacking collaboration between faculty or integration with students' prior service-learning experiences. This fragmented approach limits the development of a structured, sequential service-learning pathway that builds technical and soft skills over time. Without a coherent, integrated learning journey, as recommended by [43], students can experience opportunities for cumulative skill-building, as service-learning is often experienced only once during their programs, regardless of their academic stage.

Reflection, a cornerstone of service-learning [37], [42], [48], [50], needs to be adequately integrated into course activities. Classroom observations reveal that reflective practices are either minimal or not prioritized, and interviews show reflection is not highlighted as a key skill developed. This lack of structured reflection limits students' ability to critically assess their contributions and understand their work's broader social context and impact of their work. Some students feel unsure or embarrassed about their contributions, expressing a lack of confidence in their solutions, consistent with [42] reports. As one student noted: *they would be disappointed with the panels (...) of course, for me there is still a long way to go* (C2-S5). These feelings suggest a gap in how roles and relationships are discussed and understood, indicating that the activities involving community engagement need to be sufficiently examined regarding what is to be given and what is to be learned. Students comment that they feel they have learned more from the experience than they have contributed to the community: *it could have been better for the center, but I think it taught us more teachings than it did them* (C4-S1).

These sentiments are not fully addressed through structured reflection on students' engagement, highlighting a key challenge for future iterations of these courses to improve the overall learning experience. This gap aligns with concerns raised by authors such as [37], [41], and [45], who stress the importance of incorporating more deliberate and structured reflection activities in service-learning to deepen student learning and enhance the overall impact of community engagement efforts.

Among the challenges identified, the feedback of community partners is usually minimal and superficial and is not considered an essential part of the proposals.

Just in C1, the community referents are asked to complete a survey to evaluate the experience; in the words of the responsible teacher: *they fill out a survey. And they value the activity a little bit. And maybe that doesn't reach them* [students], *and most of them answer that everything is wonderful, and the students have all the points* (C1-T). Students express a desire for more substantial feedback to understand better how their work is valued and how it impacts the community. As one student stated: *the idea was for them* [community partners] *to come here* [to the exam presentation] *but no one came* (…) *they have a busy agenda* (C2-S2). Another student shared: *from our side there was like all the impetus to go to the center to prepare the activities but from the center I don't know how much we felt as if we were valued, I don't know if it was valued or if it was good, they came to make a proposal but it was like well, well, here come these students…* (C4-S2). The lack of structured and detailed feedback mechanisms limits students' ability to grasp the real impact of their contributions, weakening the connection between academic learning and real-world applications—an essential aspect of service-learning.

Additionally, the students express uncertainty regarding the community's actual needs and how their efforts are perceived. This uncertainty hinders their ability to critically assess their work, thereby restricting their personal growth and diminishing the overall contribution of the service-learning experience. Moreover, this gap presents a missed opportunity for mutual knowledge exchange between the university and community stakeholders, failing to incorporate community partners as active participants in the educational process, a fundamental aspect of community engagement [49]. It also limits the potential of service-learning to deepen technical and theoretical understanding while fostering critical awareness of professional roles and ethical-methodological considerations [2], reinforcing concerns raised by other scholars, such as [41] and [42].

6 CONCLUSIONS

This study presents an in-depth analysis of four engineering courses that integrate active learning and community engagement within a service-learning framework, with the aim of fostering the development of soft skills in students. Through a qualitative approach involving curriculum review, classroom observation, and interviews with instructors and students, this research highlights the potential of these courses to adapt to diverse engineering disciplines while promoting student-centered learning through real-world problem solving and direct community involvement.

The main strengths identified are the flexibility of the course design, which combines technical knowledge with experiential learning, enhancing student engagement. These models encourage the development of essential soft skills, such as teamwork, communication, and leadership, by involving students in community projects. Both teachers and students have emphasized the positive educational impact of these experiences, particularly in terms of engagement and the application of practical skills.

However, the study also identifies several challenges that hinder the long-term viability of service-learning proposals. These include low student enrollment, insufficient coordination with other service-learning initiatives, and a lack of structured feedback from community partners. Another important limitation is the need for reflection on community engagement, which limits students' ability to critically evaluate their role and contribution.

Despite these challenges, the potential of service-learning proposals in engineering education is evident. In the specific context of the Faculty of Engineering (Udelar) as a Latin American public university, where community engagement plays a crucial role, this analysis offers key perspectives to promote the strengths of service-learning and explore alternatives to overcome challenges. Improving coordination between different service-learning initiatives and promoting stronger community partnerships could generate synergies, contributing to the broader goal of strengthening community engagement.

One limitation of this study is that it only examined four courses. However, these courses represent a diverse range of service-learning offerings, demonstrating the variety and potential of service-learning in engineering. Future efforts should focus on refining course design, improving recruitment strategies, and more effectively incorporating community feedback to further deepen the impact of service-learning initiatives. Continued research should also explore the long-term impact of service-learning experiences on students' professional careers and civic engagement.

In summary, the study highlights the potential of service-learning to make valuable contributions to engineering education by combining technical expertise with community-based experiential learning. The insights gained underscore the need for continued development of innovative courses that prepare students for professional careers and active civic participation.

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