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Service Learning and Student Consulting Projects for the Development of Service Operations Management Skills

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Abstract

Engineering education has adopted active learning methodologies to address challenges such as low student engagement, limited integration between theory and practice, and insufficient development of analytical and interpersonal skills required in service operations environments. Although Service Learning and Student Consulting Projects are recognized as effective experiential approaches, empirical evidence remains limited regarding their systematic implementation in Industrial Engineering programs and their contribution to competencies in service operations management. We examine the application of Service Learning and Student Consulting Projects in the Service Operations Management course of an Industrial Engineering program in Brazil. This research analyzes two consecutive semesters with real partners: internal university services (2024/2) and external companies (2025/1). Data collection involved formative and summative assessments, student self-evaluations, partner feedback, and analysis of project deliverables. Our findings indicate that both methodologies enhanced students' analytical reasoning, communication, collaboration, and reflective abilities. Service Learning promoted community engagement and facilitated access to information, while Student Consulting Projects exposed students to authentic managerial challenges, requiring autonomy, decision-making, and adaptation to real operational constraints. Students and partners positively evaluated the experience, although challenges emerged related to time management and alignment with external stakeholders. The study contributes to engineering education by offering a replicable model for structuring experiential learning in service operations courses. Practical implications include recommendations for course redesign, partner coordination, and the purposeful integration of collaborative digital tools. The results demonstrate that experiential methodologies strengthen engineering curricula and prepare students for complex service-oriented work environments.

Keywords

Service Operations Management, Active Learning Methods, Higher Education Innovation, and Engineering Education.

1. Introduction

Engineering education has faced challenges related to low student engagement, the difficulty of connecting theory and practice, and the limitations of traditional methods that rely predominantly on lecture-based instruction. Practices centered solely on content transmission are not sufficient to promote deep understanding and intellectual autonomy (Costa and Peixoto, 2023). These dimensions are essential for preparing engineers capable of operating in complex and dynamic environments. In this context, there is a growing need for methodologies that stimulate active participation, critical thinking, and meaningful engagement with real-world problems. Active learning methodologies have become consolidated as effective alternatives to enhance learning and make the educational process more aligned

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with contemporary demands. By placing students at the center of the learning experience, these methodologies promote investigation, analysis, experimentation, collaboration, and decision-making, fundamental elements for the development of technical and transversal competencies (Brachmann et al., 2020). Research shows that action-based approaches contribute to greater engagement, improved integration between concepts and practice, and increased perceptions of relevance regarding the content studied (Dapena et al., 2022). In the field of Industrial Engineering, this discussion is even more relevant, considering that the area involves the management and improvement of processes, operations, and services, activities that require systems thinking, effective communication, analytical capacity, and teamwork (Behara and Davis, 2010). Among the active learning methodologies with potential for this purpose, Service Learning (SL) and Student Consulting Projects (SCP*)* stand out. Service Learning, as discussed by Adarlo (2025), combines practical experiences with critical reflection, stimulating metacognition and reflexivity, understood as the conscious examination of assumptions, identities, and social positioning. This approach not only connects students to real problems but also enhances their analytical capacity and awareness of impact, fostering holistic development. Student Consulting Projects, in turn, constitute an active methodology in which students act as consultants in real organizational challenges, developing diagnoses, analyses, and evidence-based recommendations. As discussed by Thompson et al. (2023), this approach creates an authentic learning environment in which students interact directly with companies and external organizations, deal with complex problems, and strengthen essential competencies such as professional communication, critical analysis, and project management. When well structured, student consulting projects promote applied learning, enhance intercultural skills, and increase students' confidence in decision-making. Moreover, findings indicate that such experiences support students' transition into more professional practices, bringing academic preparation closer to market expectations and expanding students' ability to operate in ambiguous and multidisciplinary contexts. Despite the potential of active learning methodologies, their effective application in engineering still faces important challenges (Dapena et al., 2022). In the case of Service Learning, studies show that its effectiveness depends on structured reflection processes and pedagogical conditions that are not always present in courses (Camus et al., 2021; Adarlo, 2025). Similarly, student consulting projects require complex coordination and alignment with external organizations, which makes their consistent adoption difficult (Thompson et al., 2023; Ford et al., 2023). Thus, the problem addressed in this study is to understand how Service Learning and Student Consulting Projects can be effectively implemented in a service operations management course and how they contribute to the development of the competencies expected in Industrial Engineering.

1.1 Objectives

This study aims to analyze how the Service Learning and Student Consulting Projects methodologies contribute to the development of service operations management competencies among students enrolled in the "Service Management in Production and Transportation" course of the Industrial Engineering program at the Universidade Federal do Rio Grande do Sul (UFRGS). Specifically, the study seeks to understand how these approaches, by integrating theory and practice through real projects carried out with external partners, promote the improvement of analytical, communication, teamwork, and critical reflection skills, which are essential for performing effectively in real service operations contexts. In addition, this research intends to identify the main challenges, potentialities, and conditions necessary for the effective adoption of these methodologies within the curriculum. The findings are expected to inform improvements in the course and provide support for broader strategies aimed at modernizing education in Industrial Engineering, serving as a reference for other initiatives seeking to integrate active learning methodologies in a structured and meaningful way. The adoption of these methodologies is also situated within the context of the Undergraduate Modernization Program (PMG), an initiative led by the Coordination for the Improvement of Higher Education Personnel (CAPES) in partnership with the Fulbright Commission since 2019. Within this program, the Industrial Engineering course at UFRGS has served as a pilot project for implementing a competency-based curriculum, emphasizing the integration of theory and practice, the use of active learning strategies, and assessment based on learning outcomes. As noted by Tinoco et al. (2023), the PMG has driven structural transformations in the program, supporting the development of innovative pedagogical strategies such as the systematic use of rubrics and the alignment of real-world experiences with competency development. In this context, the present study contributes by empirically examining how active learning methodologies strengthen competencies essential for contemporary industrial engineers.

2. Literature Review

Higher education has undergone significant transformations driven by the need to prepare professionals capable of dealing with complex problems, collaborating in diverse teams, and acting in a critical and reflective manner (Adarlo, 2025). In this movement, active learning methodologies have gained prominence by shifting students from the role of

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passive recipients to protagonists of the learning process. Behara and Davis (2010) highlight that experience-based practices are particularly effective, as they create real or simulated situations in which students must investigate, make decisions, and construct solutions. Experiential learning, grounded in authors such as John Dewey and systematized by David Kolb, supports this paradigm by emphasizing that learning occurs through cycles that articulate concrete experience, reflection, conceptualization, and experimentation, as discussed by Adarlo (2025). In this sense, experiential learning provides a conceptual foundation for understanding how active methodologies contribute to the development of competencies through real-world engagement and structured reflection. Within this set of practices, two methods stand out for their widespread use and their ability to bridge theory and practice: Service Learning and Student Consulting Projects.

Taken together, these characteristics position Service Learning as a methodology particularly suited for the development of socioemotional, ethical, and reflective competencies, especially in contexts that require engagement with real community needs and the consideration of social impact.

2.1 Service Learning (SL)

Service Learning is a methodology that integrates academic objectives with service actions aimed at addressing real community needs (Jenkins and Sheehey, 2011). This methodology has become a relevant pedagogical approach in engineering education by combining academic learning with the solution of real problems in community contexts. Such integration enhances student motivation, engagement, and the development of competencies essential for professional engineering practice. The specialized literature emphasizes that SL enables students to apply technical knowledge while developing socioemotional skills such as communication, leadership, teamwork, and social responsibility (Culcasi and Venegas, 2023). Systematic reviews show that SL is still underused in engineering compared to other fields, although its benefits are widely recognized. Queiruga-Dios et al. (2021) report that SL appears in introductory courses, design disciplines, community-based projects, and extracurricular activities, contributing to both technical and non-technical competencies, while also strengthening students' sense of belonging and professional identity. These authors highlight that SL offers unique opportunities for developing skills seldom addressed in traditional curricula, such as ethical responsibility, critical thinking, and the ability to work with ill-structured problems. In the specific context of industrial and systems engineering, Scherrer and Sharpe (2020) compared SL with traditional project-based learning and found significant gains in students' perceptions of their career preparation, particularly in communication, teamwork, and understanding the social impact of engineering solutions. The analysis emphasizes that the involvement of a community partner increases the authenticity of the experience and strengthens the connection between theory and practice, thereby enhancing engagement and persistence in the field. Similarly, Onal and Nadler (2017) showed that SL projects in industrial engineering promote greater applicability of knowledge and support experiential learning in real organizational environments.

More recent research expands this discussion by examining SL's contribution to the development of socioemotional and professional skills in engineering. Kongpiwatana and Hallinger (2024) demonstrate that SL improves competencies such as leadership, intercultural collaboration, and systems thinking, particularly when structured with guided reflection activities. Narong and Hallinger (2024) reinforce that reflection is a critical component of SL because it transforms practical activity into meaningful learning, enabling students to analyze the social, ethical, and professional implications of their decisions.

Therefore, Service Learning is particularly effective in fostering reflective, socioemotional, and community-oriented competencies, especially in contexts characterized by uncertainty, real constraints, and the need for evidence-based managerial recommendations.

2.2 Student Consulting Projects (SCP)

Student Consulting Projects represent an experiential method that places students in the role of consultants responsible for diagnosing and proposing solutions to real problems faced by organizations. Unlike classroom activities, this approach moves learning to external environments, requiring applied investigation, decision-making, and interaction with real clients. As argued by Heriot et al. (2008), SCP constitute a robust alternative to traditional active learning models, as they expose students to uncertainty, ambiguity, and the need to generate evidence-based recommendations for real operations and service contexts. The literature indicates that student consulting projects typically involve stages such as client identification, data collection, scoping, problem analysis, development of alternatives, and the presentation of final recommendations. The authenticity of the challenges faced is one of the central pedagogical elements: addressing ill-structured problems requires students to investigate causes, evaluate evidence, consider organizational constraints, and justify their analytical choices (Heriot et al., 2008). Furthermore, the method

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encourages the development of intellectual autonomy, since many projects involve limited direct supervision, prompting students to take initiative, negotiate expectations, and assume responsibility for results. Complementary studies reinforce the contribution of SCP to the development of advanced cognitive competencies. Canziani and Tullar (2017) demonstrate that consulting projects strongly stimulate critical thinking by requiring students to gather and evaluate information, test assumptions, verify the reliability of sources, and synthesize data to produce actionable recommendations. In the field of operations and service management, SCP have been applied as a strategy to make course content more relevant and connected to real-world contexts. Studies by Heriot et al. (2008) show that, by investigating topics such as inventory control, quality, scheduling, adoption of technology, and process flows, students gain a deeper understanding of the practical applicability of key concepts. This results in greater engagement, heightened perceptions of relevance, and the development of essential competencies such as critical analysis, professional communication, and the ability to present clear and feasible recommendations. Canziani and Tullar (2017) further emphasize that consulting projects foster argumentative skills and professional judgment, since decision-making requires evaluating multiple stakeholders, managing contradictory information, testing hypotheses, and justifying choices based on sound criteria. These processes bring academic practice closer to professional practice, preparing students to operate in complex, interdisciplinary, and problem-oriented environments.

2.3 Theoretical Positioning

This study is grounded in experiential learning theory, which conceptualizes learning as a process integrating experience, reflection, conceptualization, and experimentation (Adarlo, 2025; Motta and Galina, 2023). Within this perspective, Service Learning (SL) and Student Consulting Projects (SCP) are understood as pedagogical mechanisms that enable students to engage with real-world problems, supporting the development of analytical and reflective capabilities (Behara and Davis, 2010; Heriot et al., 2008). This research also aligns with competence-based education approaches, which emphasize the integration of technical and transversal competencies through authentic learning experiences (Pacher et al., 2024). In this context, learning involves not only knowledge acquisition but also the mobilization of skills and judgment in complex environments (Dapena et al., 2022; Culcasi and Venegas, 2023). Accordingly, SL and SCP are conceptualized as complementary approaches that support competency development through structured experiential processes, contributing to the preparation of industrial engineers for real-world service contexts (Scherrer and Sharpe, 2020; Thompson et al., 2023).

3. Methods

This study is characterized as applied research, descriptive in nature, and employing a qualitative approach, as it analyzes the implementation of active learning methodologies within a real educational context. The study was conducted in the course “Service Management in Production and Transportation,” part of the Industrial Engineering undergraduate program at UFRGS, in which the Service Learning methodology was applied in the 2024/2 semester and the Student Consulting Projects methodology in the 2025/1 semester. The course comprises a total of 60 hours—30 theoretical and 30 practical distributed over 18 weeks. It is a mandatory course in the program, combining in-class and out-of-class activities and integrating conceptual and practical content related to service management.

The empirical setting involves real organizations that partnered in the development of the practical projects carried out by the students. In the 2024/2 semester, the Service Learning methodology was adopted, emphasizing the integration of theoretical training with engagement in real social contexts, thereby fostering active learning (Dapena et al., 2022) and supporting decision-making in complex situations (Behara and Davis, 2010). In the 2025/1 semester, the Student Consulting Projects approach was implemented, enabling students to act as consultants, applying operations and production management concepts in real companies and developing solutions aligned with organizational demands (Heriot et al., 2008). Figure 1 presents the methodological approach of the project.

The study relies on multiple sources of evidence, including student self-assessments, partner feedback, and project deliverables, allowing for data triangulation and enhancing the robustness of the analysis.

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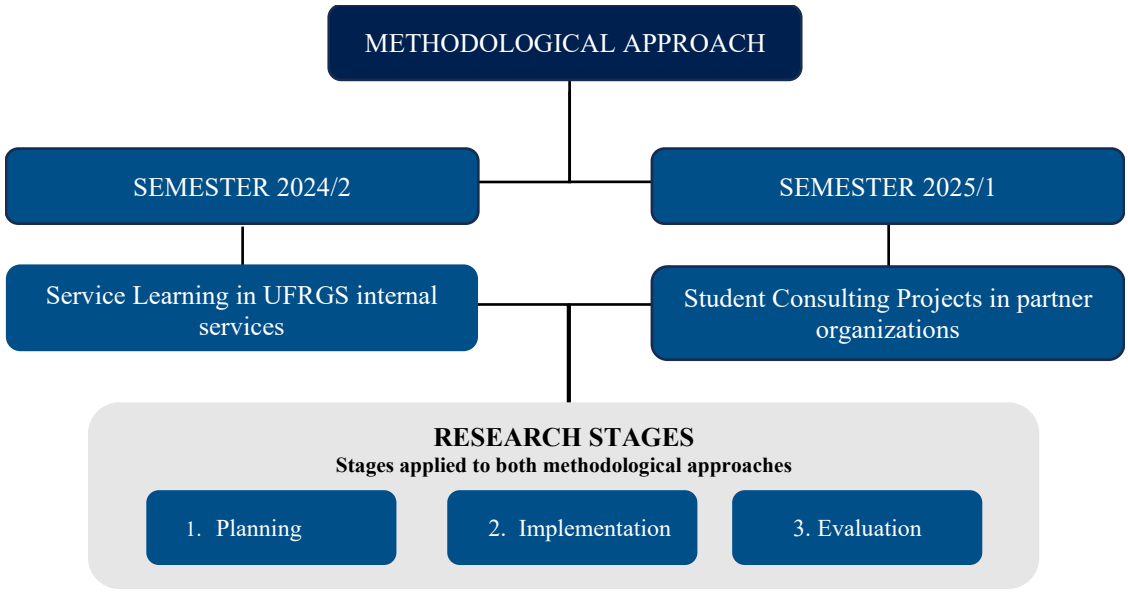

Figure 1. Methodological Approach of the Project

3.1 Research Stages

The implementation of the Service Learning and Student Consulting Projects methods in the course was organized into three stages: Planning, Implementation, and Evaluation, following the step models described in the specialized literature. In the case of Service Learning, studies show that successful experiences follow structured cycles that articulate preparation, action, and reflection, ensuring alignment between academic objectives and real-world demands (Scherrer and Sharpe, 2020; Queiruga-Dios et al., 2021; Kongpiwatana and Hallinger, 2024). Likewise, research on SCP describes processes that involve problem definition, situational analysis, client interaction, and the presentation of evidence-based recommendations (Heriot et al., 2008; Canziani and Tullar, 2017). Thus, the method adopted in the course aligns with these consolidated structures, seeking to ensure pedagogical coherence and authenticity in learning.

3.1.1. Planning

This stage took place during the initial weeks of each semester and involved defining the learning objectives related to service operations management, establishing alignment with the partners, and designing the projects that students would develop throughout the term. The SL literature highlights that the preparation stage must integrate course content with the real needs of services or the community, creating a meaningful and impact-oriented context (Kongpiwatana and Hallinger, 2024). Studies on SCP, in turn, emphasize the importance of clearly defining scopes, deliverables, and partner expectations to ensure that projects are feasible and pedagogically consistent (Heriot et al., 2008; Canziani and Tullar, 2017). In 2024/2, following a Service Learning approach, UFRGS internal services were prioritized, enabling students to propose improvements from a user perspective. In 2025/1, aligned with Student Consulting Projects, small and medium-sized local service companies were selected as partners. In this stage, a collaborative virtual workspace was developed in Notion to manage and monitor group projects, including guidelines, deliverables, assessment criteria, and peer feedback. The Miro platform was also used for in-class activities and tool development.

3.1.2. Implementation

The implementation stage involved group-based project development (five to six students per group) through direct interaction with external partners, combining diagnostic activities, data collection and analysis, process mapping, and the proposal of improvements. In line with SL studies, this phase incorporated systematic moments of reflection to foster critical thinking and enable students to connect theory, experience, and social impact (Narong and Hallinger, 2024; Culcasi and Venegas, 2023). Within the SCP context, the experience of dealing with real and ill-structured problems supported the development of competencies such as decision-making, professional communication, and rigorous analysis (Canziani and Tullar, 2017).

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3.1.3. Evaluation

The evaluation process involved both the assessment of the competencies developed by the students and the feedback provided by the partner organizations, as well as the final presentation of results. Research on SL indicates that assessment should consider students' practical performance and the quality of their reflective work, capturing their understanding of the impact of the interventions (Naik and Bandi, 2023). In SCP, evaluation typically focuses on the consistency of the analyses, the relevance of the recommendations, and students' ability to communicate well-founded solutions (Heriot et al., 2008; Canziani and Tullar, 2017). Students were assessed using both formative and summative assessments, based on the expected learning outcomes of the course (Table 1).

Table 1. Learning Outcomes and Active Learning Practices

Learning Outcomes	Active Learning Practices	Assessment Methods
RA1 – Discuss service characteristics and their implications	Flipped classroom (video + interactive quiz); Case studies (group discussion); Collaborative learning (group discussions and exercises, co-creation activities); Active learning project (Service Learning or Student Consulting Projects).	**Formative assessment:** content review quizzes; partial report of the active learning project; partial presentation of the project. **Summative assessment:** Exam 1.
RA2 – Propose service process improvements		
RA3 – Analyze key competitive priorities RA4 – Apply service marketing tools		
RA5 – Assess perceived service quality RA6 – Select operations management strategies RA7 – Conceptually design a new service RA8 - Demonstrate intermediate communication skills		**Formative assessment:** content review quizzes. **Summative assessment:** Exam 2; final report of the active learning project; final presentation; 360º evaluation.

3.2 Data Analysis

Data analysis was conducted using a combination of descriptive statistics and qualitative analysis. Quantitative data from student self-assessments were analyzed through mean and standard deviation to identify patterns in competency development. Qualitative data, including open-ended responses, partner feedback, and project deliverables, were analyzed through content interpretation to identify recurring themes related to learning outcomes and challenges. The use of multiple data sources enabled triangulation, strengthening the consistency and credibility of the findings.

3.3 Methodological Considerations

Although the study is context-specific, the structured design of the intervention and the use of multiple data sources contribute to the analytical rigor and transferability of the findings.

4. Results

The results are presented by comparing the two approaches applied in the discipline throughout the semesters 2024/2 (Service Learning) and 2025/1 (Student Consulting Projects). The analysis considers the development of learning outcomes, student engagement, interaction with partners, and the quality of final deliverables.

4.1 Semester 2024/2 - Service Learning

The Service Learning application focused on services offered by UFRGS, which facilitated access to information and motivated students through direct involvement in problems that were part of their daily experience. As presented in Table 2, the six groups analyzed different services and proposed improvements based on the tools discussed in the course. For example, Group 1 analyzed the services offered by the Student Housing Unit (*Casa do Estudante*) and proposed creating a digital platform called *Tô na Casa*, designed to integrate all necessary information and tools into a single application, facilitating and enhancing student living. The proposed functionalities included student identification, access to housing regulations and codes of conduct, a map of available services, the ability to submit requests directly to the Office of Student Affairs (PRAE), a feedback registry, and other useful features.

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Table 2. Results of the Analysis of UFRGS Internal Services

Group	UFRGS Service Analyzed*	Proposed Improvements
Group 1	Student Dorm CEU/UFRGS	Suggestions for modernizing facilities and utilizing technology to support students' academic life.
Group 2	University Restaurant	Strategies to manage high demand and improve user experience.
Group 3	Student Information Centre - TUA UFRGS	Need for more accessible technologies and a more intuitive interface.
Group 4	Antônio Bar (Campus bar)	Improvements to the menu, prices, and environment to strengthen customer loyalty.
Group 5	Dual Degree Program Office	Implementation of mentoring actions and incentives to improve the efficiency and humanization of services.
Group 6	Engineering Library	Emphasis on the importance of managing capacity, demand, and queues to increase service efficiency.

**Note: Clicking on each service name provides access to the Notion page containing the group's full report.*

The final reports demonstrated gains in analytical depth, particularly in sections related to identifying failure points in the user journey, analyzing capacity and demand, and assessing perceived quality. The quality of the submissions exceeded that of previous editions of the course, with more comprehensive and contextualized reports. Representatives of the evaluated services also expressed surprise at the relevance, feasibility, and level of detail of the proposed solutions.

In the course evaluation (n = 25), based on a student self-assessment and project evaluation questionnaire, students expressed satisfaction with the content's applicability and its proximity to real university services. Most respondents approved of using Notion as an organizational tool (88%) and found it advantageous to work with internal services (84%), primarily because of easy access to information and user familiarity. Overall, students emphasized that the approach facilitated understanding of concepts, encouraged teamwork, and fostered a clearer understanding of service operations.

Open-ended responses reinforced these findings. Many students highlighted that in-class practical activities—such as Miro exercises, Socrative quizzes, and the incremental construction of the final project—contributed to content retention and reduced overload near deadlines. Students also recognized that Notion provided clarity regarding expectations and evaluation criteria, as well as facilitated project organization.

Among the suggestions for improvement, students pointed out: (i) the need to prioritize more "tangible" internal services with larger user bases, such as the University Restaurant, Library, or Antônio Bar, to facilitate data collection; (ii) adjustments to balance digital tools, reducing the use of Miro in favor of more centralized documents on Notion; (iii) earlier application of the perceived quality questionnaire.

In summary, student responses indicate that the Service Learning approach was well-received and perceived as beneficial to learning. Students recognized that working with UFRGS internal services enabled them to visualize the direct impact of their analyses and proposals, strengthening engagement and motivation. In this sense, as in the study by Naik and Bandi (2023), students demonstrated greater interest in working on projects that align with academic learning objectives and contribute to their academic community and society. The main challenge reported was time management, as the 2024/2 semester at UFRGS was atypical, which was three weeks shorter than a regular semester. This condition highlighted the need for schedule adjustments, with better distribution of activities throughout the weeks and stronger integration between active learning practices and graded deliverables.

4.2 Semester 2025/1 - Student Consulting Projects

In the 2025/1 semester, the adoption of Student Consulting Projects provided students with an experience more closely aligned with professional environments. The five groups collaborated with small and medium-sized businesses, including a pharmacy, a beauty salon, a Muay Thai studio, a frozen meal service, and an early childhood education school (Table 3). Interactions with business owners introduced additional challenges, including scheduling visits, navigating data restrictions, and tailoring recommendations to real-world resource constraints. Even so, companies recognized the applicability of the proposed solutions and expressed interest in continued participation.

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Table 3. Results of the Analysis of Partner Organizations

GROUP	Service Analyzed*	Proposed Improvements
Group 1	Pharmacy Clinic Services	Proposal for a virtual form for service requests and virtual delivery of results; proposal of a new service (Child Health Hub) to expand clinic services.
Group 2	Muay Thai Studio	Strategic improvements focused on student experience and loyalty, strengthening competitiveness and commitment to well-being.
Group 3	Frozen Meal Service	Improvements aligned with customer demands and differentiation in a competitive market.
Group 4	Early Childhood Education School	Practical contributions focusing on parent satisfaction, children's well-being, and service efficiency.
Group 5	Beauty Salon	Strategic actions to balance demand and capacity, optimize service, and reduce perceived waiting time.

**Note: Clicking on each service name provides access to the Notion page containing the group's full report.*

As shown in Table 4 and Figure 2, the self-assessment form (n = 28) indicated high averages for all learning outcomes (4.4 to 4.8 on a 1–5 scale), with the highest scores observed for RA1 – Discussion of service characteristics (4.8) and RA5 – Construction and application of perceived quality assessment instruments (4.8). The lowest averages, though still positive, were found in more complex competencies (RA6 and RA7, both at 4.4), related to operational strategy definition and new service development. These results indicate that students understood the fundamentals of service operations and were able to transfer them to real contexts.

Table 4. Self-Assessment of Learning Outcomes

Learning Outcomes	Mean	Standard deviation
RA1 - I was able to discuss the main characteristics of services and their implications for operations management.	4.8	0.39
RA2 - I was able to propose improvements to the company's process under study based on the analysis of the customer journey and failure points.	4.7	0.55
RA3 - I was able to analyze and prioritize relevant competitive criteria to improve service operations in the company under study.	4.6	0.63
RA4 - I was able to apply service marketing tools to align the marketing mix with the company's value proposition and its target segment.	4.5	0.51
RA5 - I was able to develop and apply an instrument to assess perceived quality that was suitable for the company under study.	4.8	0.59
RA6 - I was able to select and justify operational strategies to balance demand, capacity, and queue management, considering the principles of the psychology of waiting for the service under study.	4.4	0.74
RA7 - I was able to design a new service at a conceptual level, applying stages of the service development process and service design tools to improve customer experience.	4.4	0.74
RA8 - I was able to communicate the analyses and proposals clearly and in a structured manner.	4.6	0.57

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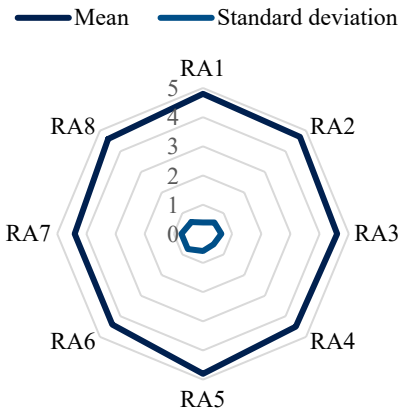

Figure 2. Graphical Representation of Self-Assessment in Learning Outcomes

Qualitative comments reinforced the positive impact of the Student Consulting Projects methodology, as students highlighted increased engagement, a strengthened sense of purpose, and the opportunity to contribute to real improvements. Students reported that working with real companies "made the theory more tangible," facilitated content retention, and offered an authentic professional experience, allowing them to visualize the impact of their recommendations. As in the 2024/2 semester, students valued in-class practical activities, such as Socrative quizzes, Miro exercises, and dedicated time for gradual project development.

However, some opportunities for improvement were identified. Students suggested: (i) adjusting project scope according to group size and project complexity; (ii) revising the workload of external activities, given that contact with partners and data collection depend on company availability; (iii) improving the structure of the final presentation, as the diversity of topics made it difficult for partners to understand priorities; and (iv) reviewing the combination of tools used, especially Miro and Notion, which some students found unintuitive at early stages, likely due to lack of familiarity.

Class scheduling and the need to coordinate company visits with internships and other courses were also mentioned as challenges. Additionally, some groups reported difficulties interacting with specific partners due to limitations in information exchange, which affected the depth of some analyses. These points underscore the importance of establishing a more structured initial alignment with companies and implementing ongoing monitoring mechanisms throughout the semester. These challenges corroborate the findings of previous studies (e.g., Canziani and Tullar, 2017; Naik and Bandi, 2023; Araújo et al., 2025) regarding the implementation of active learning approaches through interaction with real projects and partners.

Despite these challenges, partner companies evaluated the experience positively. Business owners highlighted the quality of the analyses, the feasibility of the proposals, and the students' professional conduct. All partners expressed interest in participating in future editions of the course, confirming that the university–industry collaborative dynamic was perceived as mutually beneficial.

Finally, the integration of summative assessments, student perceptions, and company feedback suggests that the active learning approach, based on real projects, contributed significantly to the development of the competencies outlined in the course syllabus. The results validate the potential of Student Consulting Projects as a methodology for Industrial Engineering programs, particularly for fostering deep, contextually grounded learning aligned with contemporary professional demands.

5 Discussion

The implementation of Service-Learning and Student Consulting Project methodologies within the Service Management in Production and Transport program enhanced students' technical, analytical, and interpersonal competencies. A comparison between the two semesters indicates that both active methodologies were instrumental in fostering contextualized learning, aligned with the contemporary demands of Industrial Engineering. The results

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demonstrate increased student engagement, strengthened analytical capabilities, and support for integrating theoretical content with real-world problems, all of which are important for education in service operations.

Service Learning, implemented in 2024/2, stood out by connecting students with the university community. Familiarity with internal services facilitated access to information and strengthened students' sense of social responsibility, supporting the development of competencies such as empathy, communication, and collaboration. These results align with studies such as Adarlo (2025) and Dapena et al. (2022), which emphasize the consolidation of learning through community engagement and critical reflection. Student Consulting Projects, implemented in 2025/1, brought students closer to a more authentic professional environment. The need to interact with companies required greater autonomy, time management, and adaptation to real constraints, reinforcing findings from Heriot et al. (2008) and Ford et al. (2023) on the benefits of placing students in direct contact with concrete organizational problems and demands.

This complementarity between approaches is also consistent with experiential learning models that emphasize the need to balance community-based exploration, professional challenges, and structured cycles of reflection (Motta, 2023). Therefore, the results reinforce that the combination of in-class practical activities, collaborative digital tools, and real-world projects contributed to integrated and engaging learning that aligns with Industrial Engineering training expectations. Furthermore, exposure to real situations, whether within the university setting or in the business context, supported the development of professional competencies required by the labor market, such as decision-making, teamwork, and communication with diverse stakeholders.

Regarding the challenges, implementing the projects required continuous effort from students throughout the semester, as the stages of diagnosis, data collection, and solution development demanded weekly dedication and coordination among group members. This limitation is recurrent in active learning initiatives, as discussed by Heriot et al. (2008), and was intensified during the atypical 2024/2 semester, whose shorter duration reduced the time available for in-depth analysis. In the following semester, the execution of the Student Consulting Projects faced additional challenges related to the availability of external partners, initial alignment of expectations, and operational limitations at each company, all of which influenced the depth of the recommendations presented. These issues align with difficulties noted by Dixon (2007), who emphasizes the importance of clear communication processes, institutional support, and continuous pedagogical follow-up for the effectiveness of external partnerships.

The results suggest that strategies such as formalizing an onboarding process for partners, defining project scopes more clearly, and intensifying the use of formative assessments mitigate challenges and enhance the impacts of active learning. Additionally, the findings highlight the value of combining multiple methodologies throughout the curriculum, distributing activities of varying complexity to stimulate both technical and human development. Figure 3 summarizes the characteristics identified in the two approaches employed. We observe that SL provided a more accessible, community-oriented context that facilitated engagement and reflection; meanwhile, SCP exposed students to higher levels of professional realism, autonomy, and analytical complexity. This comparison suggests that these approaches can serve as complementary pedagogical strategies, capable of fostering distinct dimensions of professional competence. Approaches more focused on academic services can be undertaken during the initial semesters, followed by subsequent applications in external services or industry.

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Dimension	Service Learning (2024/2)	Student Consulting Projects (2025/1)
Context	Internal university services	External organizations
Student familiarity	High	Moderate
Access to information	Easier	More restricted
Professional realism	Moderate	High
Social/community engagement	High	Moderate
Analytical complexity	Moderate	High
Stakeholder dependency	Lower	Higher
Autonomy required	Moderate	High
Main challenge	Time constraints	External coordination
Main competency strengthened	Reflection and engagement	Decision-making and autonomy

Figure 3. Comparative Characteristics of Service Learning and Student Consulting Projects

From a theoretical standpoint, we demonstrate empirically how different models of experiential learning can be articulated to strengthen competencies in service operations, an area still underexplored in the literature. The structured description of the planning, execution, and evaluation stages also provides a replicable model for researchers and instructors interested in implementing similar initiatives, broadening the discussion on methodologies applied to engineering education. From an institutional perspective, the results reinforce the importance of pedagogical environments that integrate reflection, guided practice, and interaction with diverse audiences (both internal and external) as the foundation for a training model aligned with the current demands of the productive sector. Future research may explore the application of these methodologies in other Industrial Engineering courses, assess their long-term impacts on students' academic and professional performance, or investigate the mediating role of digital tools in strengthening collaborative learning. One limitation of this study is the potential for student self-assessment bias. However, the triangulation with partner feedback and project deliverables strengthens the consistency of the findings. Jointly, the findings confirm the potential of active methodologies to transform Industrial Engineering education, making it more connected, reflective, and oriented toward real-world problems as highlighted by Scherrer et al. (2020).

6. Conclusion

The integrated implementation of Service Learning and Student Consulting Projects in the Service Management in Production and Transportation course proved effective in promoting learning and developing the competencies required for Industrial Engineering training. Service Learning brought students closer to the social and institutional demands of the university. At the same time, the Student Consulting Projects offered an experience more closely aligned with professional practice, involving challenges typical of real business environments.

From a scientific perspective, this study advances the state of the art by empirically demonstrating how different forms of experiential learning can be systematically articulated to strengthen technical and transversal competencies in operations management. This field still receives limited attention in literature on active learning methodologies. It also contributes by presenting an implementation model in sequential stages (planning, execution, and evaluation) that guides instructors and researchers interested in replicating or adapting similar initiatives.

From a practical perspective, the findings provide guidelines for Industrial Engineering programs seeking to modernize their curricula. The evidence shows that combining in-class practical activities, the use of digital tools, interaction with real partners, and continuous formative assessment enhances engagement, analytical depth, and professional development. Engineering curricula can benefit from the progressive integration of experiential methodologies, with increasing levels of complexity and external interaction, as we first investigated university services and subsequently tested the application in external contexts.

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The methodologies adopted align with the objectives of the Brazil–United States Higher Education Program for Modernization (PMG), enhancing the quality of training and promoting pedagogical practices that better reflect the contemporary complexity of engineering work. The continuation of these initiatives, incorporating adjustments suggested by students and partners, has the potential to consolidate an innovative, sustainable, and replicable teaching model in different academic contexts. Future studies may explore the application of these methodologies in other courses and areas within Industrial Engineering, as well as investigate their long-term effects on students' academic and professional performance.

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