Integrating Soft Skills into Core Engineering Courses Through Didactic Workshops

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Abstract

In a globalized and rapidly evolving professional context, soft skills play a critical role in engineering education by supporting effective communication, teamwork, adaptability, and ethical decision-making. Accreditation frameworks such as ABET emphasize student outcomes related to these professional competencies; however, their systematic integration into core engineering curricula remains challenging. This study examines the implementation of structured, didactic soft skills workshops embedded within a third-year core engineering course at the E.S. Witchger School of Engineering at Marian University in Indianapolis, involving a multidisciplinary cohort of undergraduate students.

The intervention consisted of twelve weekly workshops aligned with course content and two ABET student outcomes related to communication and teamwork. A total of 38 students across two course sections participated in the study. A pre–post survey design was used to examine changes in students' self-reported perceptions of soft skills development and the relevance of these competencies within a technical course context. Results indicate positive shifts in students' perceptions of selected soft skills and a stronger perceived connection between professional competencies and technical course content compared to standalone skills-focused experiences. Students also reported increased awareness of the importance of these competencies for professional engineering practice.

This work presents a feasible and scalable instructional model for integrating soft skills into core engineering courses without displacing technical content. The findings contribute to the engineering education literature by illustrating an accreditation-aligned pedagogical approach that supports the concurrent development of technical and professional competencies in multidisciplinary learning environments.

Keywords: Soft skills, Engineering education, Active learning workshops, ABET, Multidisciplinary engineering, Core courses.

1. Introduction

In today's professional landscape, characterized by globalization and rapid technological change, engineering graduates are expected to demonstrate not only strong technical competence but also well-developed professional (soft) skills, including communication, teamwork, adaptability, ethical judgment, and leadership. Prior research consistently shows that employers value these competencies as critical determinants of engineers' job performance and employability, often ranking them alongside or above technical expertise (Hirudayaraj et al., 2021). Despite this consensus, a persistent gap remains between the soft skills cultivated during undergraduate engineering education and those required in professional practice, particularly in communication, teamwork, and professional effectiveness (Fletcher et al., 2016; de Campos et al., 2020; Laguna et al., 2025).

Accreditation frameworks have played a central role in elevating the importance of professional competencies within engineering education. ABET accreditation criteria explicitly define student learning outcomes related to effective communication, teamwork, ethical responsibility, and problem solving in diverse contexts (Naimpally et al., 2011; Hirudayaraj et al., 2021). Engineering education suggests that outcome-driven curricular designs aligned with ABET criteria can strengthen alignment between academic preparation and professional practice by embedding professional competencies within technical coursework (Skvarenina, 2004).

Nevertheless, the consistent and meaningful integration of soft skills into technical engineering curricula remains challenging. Traditionally, these competencies have been addressed through standalone courses, extracurricular workshops, or isolated activities that students often perceive as disconnected from core technical content. Such fragmented approaches have been shown to limit the transfer of professional skills to authentic engineering contexts, reducing students' perception of their relevance to real-world practice (Vasko, 2011).

In response, recent scholarship in engineering education has advocated for instructional approaches that embed soft skill development directly within technical courses. Studies have documented positive outcomes when communication, collaboration, and critical thinking are incorporated into core engineering coursework, including improvements in students' professional preparedness and engagement (McCall, 2024; Moscoso-Barrera, 2024). Complementary efforts have also highlighted project-based and extracurricular experiences as effective mechanisms for fostering professional competencies (Buten, 2025).

Despite growing interest in these approaches, empirical evidence remains limited regarding structured and sustained implementations of soft skills workshops embedded within required, multidisciplinary engineering courses across an entire academic semester. This paper addresses this gap by examining the integration of weekly, course-embedded soft skills workshops into a third-year core engineering course at Marian University, explicitly aligned with ABET student learning outcomes. The study evaluates changes in students' perceptions of their professional skills and proposes a scalable instructional model for integrating soft skills into core engineering curricula without displacing technical content.

2. Background and Related Work

Soft skills such as communication, teamwork, critical thinking, and decision-making are widely recognized as essential competencies for engineering graduates, as contemporary engineering practice increasingly requires collaboration in multidisciplinary teams and effective communication with diverse stakeholders. Numerous studies in engineering education have emphasized that professional competencies are critical complements to technical expertise and play a significant role in engineers' workplace effectiveness and career success. Despite this recognition, the systematic integration of soft skills within undergraduate engineering curricula remains limited, and these competencies are often insufficiently embedded within required technical courses, restricting opportunities for contextualized practice and assessment (Shuman et al., 2005; Passow, 2012; Marin-Mantilla, 2025).

Accreditation frameworks, particularly those defined by ABET, have reinforced the importance of professional competencies by explicitly articulating student learning outcomes related to communication, teamwork, ethical responsibility, and problem solving. However, while these outcomes establish clear expectations, they offer limited guidance regarding instructional implementation. As a result, many programs rely on standalone courses or indirect strategies to address soft skills, which may weaken students' ability to connect these competencies with technical content. Prior research suggests that embedding soft skills within core engineering courses—through active learning strategies such as workshops—offers a more authentic, assessable, and accreditation-aligned approach that coherent integration of professional and technical learning (Felder & Brent, 2003; Prince, 2004; ABET, 2023).

3. Course Context and Educational Setting

This study was conducted at Marian University within the Witchger School of Engineering in *Global Engineering*, a required third-year core course taken by students from multiple undergraduate engineering programs. The course introduces key concepts in engineering ethics, sustainability, and the fundamental engineering design process, serving as a multidisciplinary learning environment that integrates technical and professional objectives.

The study was implemented during the Fall 2025 semester and involved 38 students (mean age = 20.4 ± 1.2 years) distributed across two sections taught by the same instructor using an identical syllabus, instructional structure, and assessment framework. All students received the same technical instruction and participated in the same integrated soft skills workshops as part of the regular course schedule.

For the purposes of this study, the course emphasized two ABET-aligned student outcomes defined by the School of Engineering at Marian University. SO3 focused on effective communication with diverse audiences and was assessed through performance indicators addressing appropriate use of engineering conventions in written communication and effective oral presentation. SO5 addressed students' ability to function effectively on multidisciplinary teams, including leadership, goal setting, task planning, and collaboration. These outcomes were evaluated using analytic rubrics applied to two course projects and selected workshop activities, ensuring alignment among instructional activities, assessment strategies, and accreditation expectations.

The multidisciplinary composition of the course—Biomedical Engineering (1), Chemical Engineering (5), Civil Engineering (8), Computer Engineering (4), Engineering Physics (2), and Mechanical Engineering (18)—provided an authentic setting for soft skills instruction. Students regularly interacted with peers from different engineering disciplines, creating learning experiences that reflected real-world engineering collaboration and reinforced the relevance of professional competencies within a core technical course.

4. Materials and Methods

4.1 Instructional Design and Workshop Implementation

The instructional intervention consisted of twelve structured soft skills workshops embedded within the regular structure of a third-year core engineering course. Rather than being delivered as standalone activities, the workshops were integrated into the weekly course schedule and aligned with the technical content addressed throughout the semester. One of the three weekly class sessions was consistently dedicated to workshop implementation, ensuring continuity without reducing technical coverage.

Each workshop targeted a specific professional competency relevant to engineering practice, including communication, teamwork, active listening, creativity, critical thinking, and decision-making. The selection of these competencies was guided by accreditation requirements, employer-identified needs for twenty-first-century engineers, and course-level instructional objectives (Lavi et al., 2021).

All workshops followed a consistent three-phase instructional structure. Each session began with a brief conceptual introduction that defined the targeted skill and explicitly situated it within an engineering context. This was followed by an active learning activity designed to promote application of the skill in a realistic, course-related scenario, such as collaborative problem solving, role-playing, or design challenges. Workshops concluded with a structured reflection in which students examined their performance, the role of the targeted skill, and its relevance to both course content and professional engineering practice. In selected sessions, short post-activity surveys were administered to capture immediate student feedback.

Workshop activities were explicitly aligned with the course's three primary thematic areas—engineering ethics, sustainability, and the engineering design process, reinforcing the view of soft skills as integral components of effective engineering practice. Given the multidisciplinary enrollment of the course, workshops were intentionally structured to promote interaction among students from different engineering programs. Group formation considered both disciplinary background and results from a personality profiling instrument, supporting exposure to diverse perspectives and collaborative dynamics throughout the semester.

Example Workshop Activities

To illustrate the structure and integration of the workshops, two representative examples are described below.

Decision-Making Workshop. The session began with a conceptual introduction defining decision-making as the ability to identify alternatives, evaluate evidence and risks in relation to goals and constraints, and select and implement a course of action while learning from outcomes. The importance of structured decision processes in uncertain and high-stakes engineering contexts was emphasized.

This was followed by an active learning activity based on a survival scenario in which students imagined they had experienced a plane crash in a desert environment. Working first individually and then in small groups, students were asked to prioritize a set of salvaged items according to their importance for survival. The activity incorporated structured discussion guidelines that encouraged active listening, discouraged voting, and promoted consensus-building through reasoned argumentation. The goal was to simulate real-world engineering decision-making under uncertainty, where incomplete information, risk evaluation, and team dynamics influence outcomes. The workshop concluded with a structured reflection in which students analyzed how their decisions evolved from individual to group settings, identified criteria used for prioritization (e.g., risk versus benefit, short-term versus long-term impact), and examined the role of cognitive biases and group dynamics in shaping decisions. Students also reflected on how effective communication and collaborative reasoning contributed to improved outcomes.

Teamwork and Collaboration Workshop. The session began with a conceptual introduction distinguishing teamwork as the coordinated execution of interdependent tasks with defined roles, and collaboration as a more flexible process involving shared responsibility, mutual support, and joint decision-making. The importance of both approaches in engineering practice was highlighted.

The active learning activity was structured in two contrasting phases. In the first phase, students worked in teams to complete a hands-on construction task (assembling a 3D figure) under restrictive conditions: no verbal communication and no cross-support among team members. Each student was assigned a specific role (e.g., cutting, coloring, folding, assembly), and success depended on coordination despite limited interaction. In the second phase, teams were allowed to plan their strategy, communicate freely, and support each other across roles. This design enabled direct comparison between strictly divided teamwork and collaborative approaches, highlighting differences in efficiency, coordination, and quality of outcomes. The session concluded with a structured reflection in which students compared both phases, identifying bottlenecks, communication barriers, and the impact of planning and cross-support on performance. Students discussed how role flexibility, communication, and shared responsibility improved outcomes, and derived actionable strategies applicable to their course projects and future engineering teamwork.

These examples illustrate how workshops were explicitly aligned with course topics such as engineering ethics and the design process.

4.2 Assessment Instruments and Data Collection

To evaluate the impact of the integrated workshops, a mixed-methods assessment strategy was employed using pre- and post-semester surveys. Data collection focused on students' self-reported perceptions of soft skills development and the perceived relevance of these competencies within a core engineering course. Surveys were administered during the first and final weeks of the semester, and students were informed of the study purpose and the voluntary nature of participation.

The survey instrument comprised five sections—Teamwork Skills, Communication and Professional Skills, Emotional Intelligence, Critical Thinking and Problem Solving, and Open-Ended Questions—for a total of 30 items. Twenty-five items used a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), while five items were open-ended. Survey items were intentionally aligned with both the soft skills addressed in the workshops and the ABET student outcomes emphasized in the course.

All enrolled students were invited to participate, and responses were anonymized prior to analysis. A total of 38 students completed both the pre- and post-surveys, yielding paired data suitable for within-subject comparisons. Given the ordinal nature of Likert-scale data and the paired pre–post design, nonparametric statistical methods were selected. Descriptive statistics were used to summarize response distributions, and visualizations such as histograms and boxplots were generated to illustrate changes over time. The Wilcoxon signed-rank test was applied to assess differences between pre- and post-survey responses, using a standard significance level of $\alpha = 0.05$.

6. Results

6.1 Quantitative Results

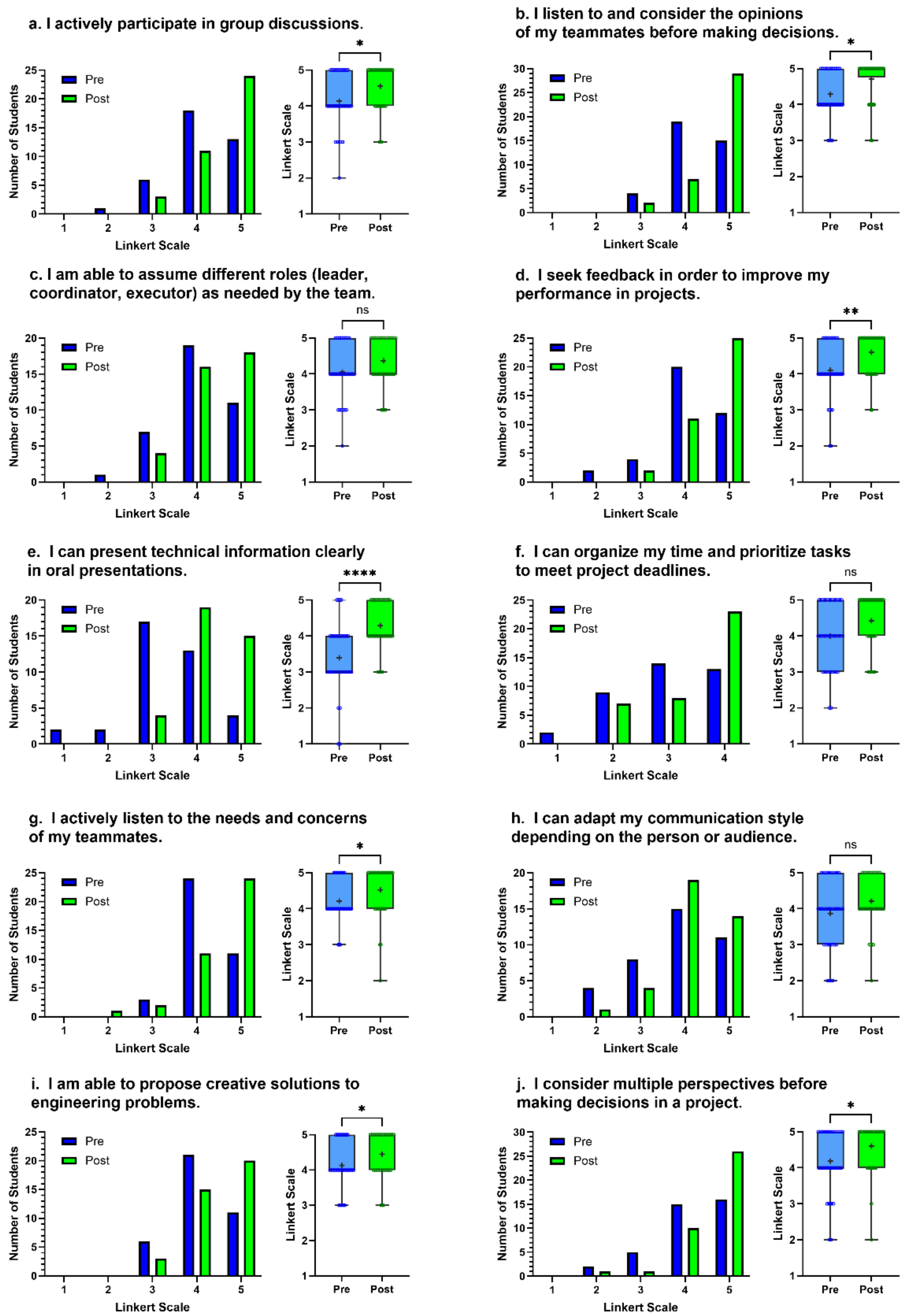

Figure 1. Histograms and boxplots comparing pre- and post-survey responses for selected soft skills items. Post-survey responses exhibit higher median values and reduced variability, indicating improved student perceptions following the workshop intervention (n = 38, paired Wilcoxon signed-rank test).

Overall, descriptive statistics revealed an increase in students' self-reported soft skills across the evaluated dimensions following the integration of the workshops. Figure 1 illustrates results for a subset of ten items drawn from the 25 Likert-scale questions included in the pre–post survey. For each item, histograms display the distribution of student responses, while boxplots compare pre- and post-intervention data.

Of the ten items shown, two (items e and h) correspond to ABET SO3 (communication), while the remaining items align with ABET SO5 (teamwork). Seven of the ten items showed differences with p-values below 0.05; however, given the number of comparisons conducted, these results should be interpreted with caution due to the increased likelihood of Type I error. These findings are therefore presented as exploratory indicators of change rather than definitive evidence of statistical significance. Effect sizes and descriptive trends were also considered to support interpretation of the results. Notably, students reported an increase in perceived participation during group discussions. In contrast, items related to assuming specific team roles, time organization and task prioritization, and adapting communication to different audiences did not reach statistical significance, identifying areas where additional instructional strategies may be warranted.

Figure 2 summarizes results from a post-activity survey administered after the Teamwork and Collaboration workshop, using a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

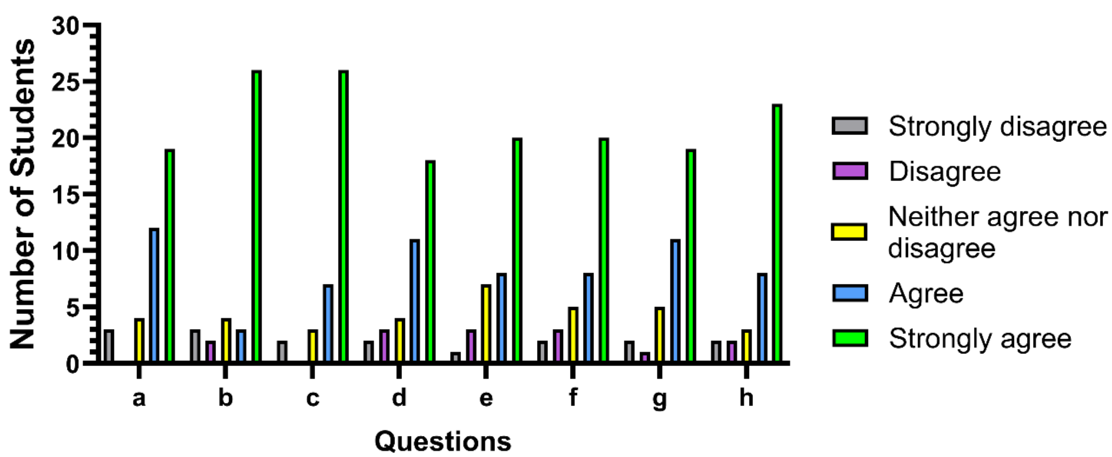

Figure 2. Post-workshop survey responses for the Teamwork and Collaboration workshop: (a) clear planning, (b) role clarity, (c) effective contribution, (d) clear and timely communication, (e) collaboration and support, (f) balanced workload, (g) adaptation to challenges, and (h) achievement of objectives.

Greater response dispersion was observed for items related to communication (item d) and workload distribution (item f). This pattern aligns with the non-significant results observed in Figure 1 for communication adaptation and internal team organization, suggesting that while overall teamwork perceptions improved, communication clarity and task distribution remain areas for targeted instructional refinement.

Figure 3 presents rubric-based performance results for the performance indicators (PI) associated with the two ABET student outcomes addressed in the course.

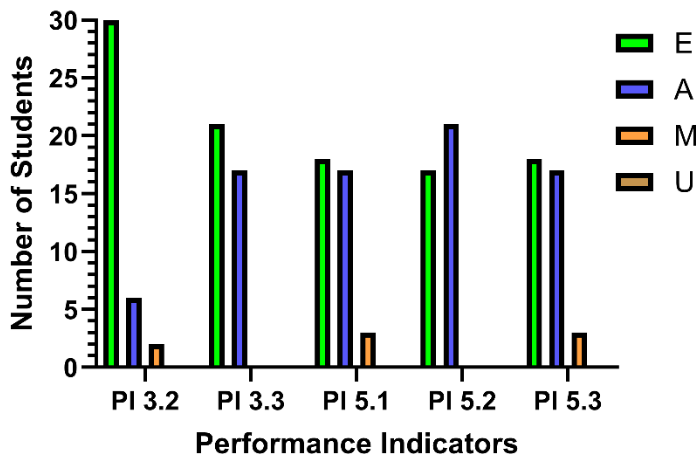

Figure 3. Distribution of performance levels (E = Exemplary, A = Adequate, M = Marginal, U = Unsatisfactory) for ABET performance indicators: PI 3.2. employ proper use of scientific and/or engineering conventions in technical communication, including appropriate citation of sources; PI 3.3, deliver an effective oral presentation and respond appropriately to questions from both technical and non-technical audiences; PI 5.1, take leadership responsibility for the success of the team in meeting objectives; PI 5.2, establish goals, plan tasks, and meet objectives; and PI 5.3, work effectively with multidisciplinary team members to address differences in perspective and approach to team tasks.

Based on rubric-based assessments of two course projects, 100% of students achieved Exemplary or Adequate performance in PI 3.3 (oral communication) and PI 5.2 (goal setting and task planning). For the remaining indicators, 92% of students achieved E or A ratings. A small number of students (2–3 per indicator) received Marginal ratings, indicating opportunities for further instructional support in technical communication, leadership, and multidisciplinary teamwork.

6.2 Qualitative Results

Qualitative data from open-ended survey responses (n = 38) provided complementary evidence supporting the quantitative findings. Responses were thematically coded, resulting in four dominant themes: communication, leadership, teamwork, and perceived impact of the workshops.

Communication. Students demonstrated awareness of the need to adapt technical communication to different audiences, emphasizing simplification, audience analysis, and the use of visuals or examples. As one student noted, *"If the audience is not technical, I remove the formulas and focus on the main idea."* These responses indicate an emerging understanding of communication as contextual and audience-dependent.

Leadership. Students described leadership in practical terms, emphasizing planning, initiative, coordination, and accountability rather than formal authority. One student reflected, *"Being a leader can be overwhelming, but knowing your team helps achieve better outcomes."* This suggests a functional and experience-based conception of leadership.

Teamwork. Students highlighted organization, fairness, communication, and active listening as key contributions to team effectiveness. Statements such as *"I make sure everyone is heard"* and *“I help divide the work fairly”* reflect recognition of both task-oriented and interpersonal dimensions of collaboration.

Impact of the Workshops. Students consistently reported increased confidence, engagement, and opportunities for active practice for soft skills. Many emphasized the experiential nature of the workshops, noting personal and professional growth. One student stated, *“The workshops pushed me out of my shell and helped me improve both teamwork and public speaking skills.”*

Collectively, the qualitative findings corroborate the quantitative results, indicating that students perceived the workshops as meaningful learning experiences that contributed to the development of professional competencies within a core engineering course.

7. Discussion

The results of this study suggest that the intentional integration of soft skills development into a core engineering course through didactic workshops may positively influence students’ perceptions of their professional competencies. The observed increases in post-survey responses, together with reduced variability across several items, indicate not only perceived improvement but also greater consistency in how students conceptualize their soft skills development.

One particularly relevant finding was the observed increase in students’ perceived participation in group discussions. This outcome is especially meaningful within a multidisciplinary course context, where effective communication and active engagement are central to collaborative learning. The structured and recurring nature of the workshops likely contributed to this result by providing repeated opportunities for students to practice communication and teamwork in authentic, course-related scenarios, rather than in isolated or abstract activities. This observation aligns with prior research emphasizing the role of experiential and self-directed learning in strengthening communication, leadership, and interpersonal skills among engineering students (Barhoumi, 2023).

These findings, while exploratory, are consistent with existing literature suggesting that soft skills are more effectively developed when embedded within technical courses rather than addressed through standalone or extracurricular interventions. By integrating workshops directly into a core course, students were able to apply professional competencies concurrently with technical content, reinforcing their relevance to engineering practice. This contextualized application may help explain why students reported a stronger connection between the workshops and course learning than is commonly observed in skills-focused courses offered separately from technical instruction.

The multidisciplinary nature of the course further reinforced the importance of soft skills as essential engineering practices. Interacting with peers from different engineering programs exposed students to diverse perspectives and problem-solving approaches, closely mirroring professional engineering environments. Within this context, soft skills were not framed as supplementary attributes but emerged as necessary tools for effective collaboration, decision-making, and learning.

From an instructional standpoint, the feasibility of the intervention represents a key contribution. The workshops were implemented within the existing course structure without reducing technical content or requiring additional instructional time. This demonstrates that meaningful integration of professional skills can be achieved through instructional design choices rather than curricular expansion, addressing a common concern among engineering faculty related to time constraints and content coverage.

It is also important to consider that multiple statistical comparisons were conducted across survey items without adjustment for multiple testing. As a result, some observed differences may reflect an increased likelihood of Type I error. Therefore, the quantitative results should be interpreted as indicative trends rather than definitive statistical conclusions. Future analyses could incorporate correction methods, such as Bonferroni or false discovery rate adjustments, to strengthen the robustness of statistical inferences.

In addition, the pre–post assessment framework employed in this study represents a potentially transferable approach for evaluating the impact of curricular interventions in engineering education. Beyond this specific implementation, such a design may support future efforts to benchmark typical variation in student perceptions and assess the effectiveness of similar instructional strategies across different courses and contexts.

Recommendations, Limitations, and Future Work

Based on the implementation and outcomes of this study, several recommendations can be offered. Soft skills workshops should be intentionally aligned with course learning objectives and accreditation outcomes to reinforce relevance and support systematic assessment. Integrating workshops into regular class time—rather than offering them as supplemental activities—helps position professional competencies as integral to engineering practice while avoiding increased student workload. Maintaining a consistent workshop structure, including a brief conceptual introduction, active learning component, and structured reflection, can further support student engagement and instructional efficiency. Additionally, promoting multidisciplinary interaction during workshop activities enhances exposure to diverse perspectives and approximates professional engineering contexts.

The results should be interpreted in light of several limitations. The study was conducted within a single course at one institution, which may limit generalizability. Furthermore, the assessment relied primarily on self-reported perception data, which may not fully capture changes in observable performance. Additionally, while pre–post comparisons were based on students' self-reported perceptions, ABET-aligned performance assessments were conducted only at the end of the course. This discrepancy limits the ability to directly evaluate changes in observable performance aligned with accreditation outcomes. While such measures provide valuable insight into student awareness, motivation, and engagement, future studies could strengthen assessment by incorporating complementary methods, such as peer evaluation, instructor observation, or performance-based measures.

Future research should also examine the long-term impact and transferability of integrated soft skills instruction through longitudinal designs that explore skill retention across subsequent courses or professional experiences. Additional studies across different course levels, class sizes, and instructional modalities—including hybrid or online formats—would help clarify the scalability and adaptability of this approach. Exploring relationships between soft skills development and academic or project-based performance may further elucidate the value of integrated instructional strategies in engineering education.

8. Conclusions

This work demonstrates that soft skills instruction can be meaningfully and effectively integrated into core engineering coursework through structured, course-embedded workshops aligned with technical content and accreditation expectations. The proposed approach shows that professional competencies can be addressed within existing curricular frameworks, avoiding the need for additional courses or reductions in technical coverage. As such, this study offers a practical and viable pathway for engineering programs seeking to respond to accreditation requirements and industry demands through instructional design rather than curricular expansion.

Additionally, the findings underscore the value of soft skills as integral engineering practices when taught within authentic, multidisciplinary technical contexts. Embedding communication, teamwork, and decision-making within course-related learning activities supports a more coherent educational experience in which technical and professional competencies are developed concurrently. This integrated model contributes to ongoing efforts in engineering education to promote holistic student preparation and provides a transferable, accreditation-aligned pedagogical strategy for faculty pursuing scalable instructional innovations.

References

ABET. (2023). *Criteria for accrediting engineering programs, 2023–2024*. ABET. https://www.abet.org

Barhoumi, E. M. (2023). The effects of controlled self-learning on the improvement of soft and cognitive skills of engineering students: A focused analysis. *Learning And Motivation*, *83*, 101915. https://doi.org/10.1016/j.lmot.2023.101915

Buten, E. (2025). Understanding the development of professional skills in extracurricular engineering project teams. ASEE Conference Proceedings.

de Campos, D., Resende, L., & Fagundes, A. (2020). Soft skills by engineering employers. Creative Education, 11, 2133–2152. https://doi.org/10.4236/ce.2020.1110152

Felder, R. M., & Brent, R. (2003). Designing and teaching courses to satisfy the ABET engineering criteria. *Journal of Engineering Education*, 92(1), 7–25. https://doi.org/10.1002/j.2168-9830.2003.tb00734.x

Fletcher, A. J., Sharif, A. W. A., & Haw, M. D. (2016). Using the perceptions of chemical engineering students and graduates to develop employability skills. *Education For Chemical Engineers*, *18*, 11-25. https://doi.org/10.1016/j.ece.2016.07.001

Hirudayaraj, M., Baker, R., Baker, F., & Eastman, M. (2021). Soft skills for entry-level engineers: What employers want. Education Sciences, 11(10), 641. https://doi.org/10.3390/educsci11100641

Kolmos, A., de Graaff, E., & Du, X. (2009). *Diversity of PBL – PBL learning principles and models*. In X. Du, E. de Graaff, & A. Kolmos (Eds.), *Research on PBL practice in engineering education* (pp. 9–21). Brill | Sense. https://doi.org/10.1163/9789087909321_003

Laguna, R. F. D., Aguinaga, D. L., Torres, D. E. C., & Cueto, B. A. L. (2025). Soft skills and the use of industry 4.0 as determinants of professional development in engineering graduates: A SEM approach. Sustainable Futures, 10, 100742. https://doi.org/10.1016/j.sftr.2025.100742

Lavi, R., Tal, M., & Dori, Y. J. (2021). Perceptions of STEM alumni and students on developing 21st century skills through methods of teaching and learning. *Studies In Educational Evaluation*, *70*, 101002. https://doi.org/10.1016/j.stueduc.2021.101002

Marin-Mantilla, K. J., & Moscoso-Barrera, W. D. (2025). Development of a STEM Teaching Strategy to Foster 21st-Century Skills in High School Students Through Gamification and Low-Cost Biomedical Technologies. Education Sciences, 15(12), 1624. https://doi.org/10.3390/educsci15121624

McCall, M. M. (2024). Developing teamwork skills across the mechanical engineering curriculum. ASEE North Central Section Conference Proceedings.

Moscoso-Barrera, WD. (2024). An Iterative Design Approach in Biomedical Engineering Student Group Projects. ASEE Conference Proceedings.

Naimpally, A., Ramachandran, H., & Smith, C. (2011). Accreditation of Engineering Programs and Their Relationship to Lifelong Learning. En *Elsevier eBooks* (pp. 11-19). https://doi.org/10.1016/b978-0-12-385214-4.00003-9

Passow, H. J. (2012). Which ABET competencies do engineering graduates find most important in their work? *Journal of Engineering Education*, 101(1), 95–118. https://doi.org/10.1002/j.2168-9830.2012.tb00043.x

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, 93(3), 223–231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

Shuman, L. J., Besterfield-Sacre, M., & McGourty, J. (2005). The ABET "professional skills" — Can they be taught? Can they be assessed? *Journal of Engineering Education*, 94(1), 41–55. https://doi.org/10.1002/j.2168-9830.2005.tb00828.x

Skvarenina, T. (2004, June). Incorporating ABET "Soft Skills" Into Energy Conversion Courses. Paper presented at the 2004 ASEE Annual Conference, Salt Lake City, Utah. https://peer.asee.org/13126

Vasko, T. J. (2011). Assessment of soft skills program learning outcomes using engineering courses. ASEE Annual Conference Proceedings.