ŌTAUTAHI CHRISTCHURCH AOTEAROA NEW ZEALAND
35TH AUSTRALASIAN ASSOCIATION FOR ENGINEERING EDUCATION ANNUAL CONFERENCE
8-11 DEC 2024
THE ENGINEER AND THE WORLD

Professional skills – the balancing act!

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ABSTRACT

CONTEXT

Globalisation and ever-changing technology require the modern engineer to acquire a broad skill set to be able to contribute to the profession and to society at large. Engineers Australia includes a set of competencies, categorised as “professional and personal attributes” that graduating engineers must possess for them to operate in an “informed, responsible and sustainable fashion”. Several researchers have pointed out the inadequacy in the level of development of these attributes in recent graduates, and the gaps in higher education with respect to teaching these.

PURPOSE OR GOAL

The purpose of this paper is to share preliminary findings from research in progress on academic perspectives around the development and assessment of professional skills in undergraduate engineering programs in the Australian context. The paper will report on findings from academics from GO8, ATN and RUN universities, elaborating their views on the terminology around these skills and what they consider as effective ways to develop and assess professional skills.

APPROACH

A qualitative approach was adopted for the study, specifically using ‘phenomenography’. Semi structured interviews were conducted with 10 academics, who were selected using a purposeful sampling technique. The data collected was analysed using NVivo and data driven, structural coding was used. A codebook was created, and the information coded was further organised and subsequently analysed, using the framework matrix within NVivo.

OUTCOMES

The study brings out the current Australian academic perspective on some of the ways undergraduate engineering students can be helped to develop professional skills while also discussing some assessment strategies. The study discusses the current view on the appropriate terminology for these skills, to enable a mindset shift in academics and engineering students, helping them appreciate their importance.

CONCLUSIONS

Based on the findings, academics continue to recognise the importance of professional skills and the terminology around these skills. Academics discussed various strategies that could be implemented within engineering programs, to help with the development and assessment of professional skills.

KEYWORDS

Professional skills, development and assessment, phenomenography, engineering education, NVivo

Introduction & Background

The success of future engineers, hinges on their ability to navigate complex, often uncertain projects, collaborate within multicultural teams, and adapt to the paradigm shift toward remote and virtual work environments. To be able to do that, while technical skills continue to be important, professional skills are now considered to have increasing importance(Ballesteros Sánchez et al., 2017). The Australin Council of Engineering Deans (ACED) report (Engineering 2035), a project to reshape Australian engineering education for the future, talks of a T-shaped graduate, saying that this graduate should have attributes that include strong discipline-based knowledge along with transferable skills (Lee et al., 2022).

To meet industry's increasing demand for students with better professional skills, educational institutes need to adopt strategies and accordingly make provision for the same in their curricula (Munir, 2022). This is echoed by the ACED report which says that entry-level engineering degree programs must make critical changes to enhance student's "exposure to engineering practice, deepen the core engineering thinking (habits of mind), and strengthen the coverage of the human and societal contexts in which engineering is situated" while integrating it with the technical skills (Lee et al., 2022, p. 38).

There is however another issue that needs to be addressed which is around the terminology. Professional skills for the past 20 years have been predominantly addressed as 'soft skills', which has led to several issues. Firstly, as Berdanier(2022) says, addressing these skills as 'soft' makes students believe that these skills are not essential. Secondly, it hinders the integration of these skills into the learning outcomes and thirdly, it impacts how we assess them (Berdanier, 2022). Researchers have spoken of the importance of the language around these skills and as Berdanier (2022) says "perhaps the time for change has finally come: It starts with our language". Getting the language right will enable students to pay attention to these skills (Holloway & Linvill, 2023), elevating them as "core engineering skills" while also motivating academics to be "exceptional collaborators, communicators, and inclusive teachers" besides maintaining excellence in research (Berdanier, 2022).

Various accrediting bodies including Engineers Australia require engineering programs to include development of 'professional and personal attributes' as part of the competencies required of an engineer, but research has shown that the gap between engineering education and what is required in the world of practice has widened(Buckley et al., 2021) and that most programs are not giving professional skills the importance they deserve, failing to explicitly teach some of these skills (Rajabzadeh et al., 2022). In a recent study, it was pointed out that nearly 94% of the participating students agreed that "soft skills should be included in the professional training of engineers, with 86% affirming that soft skills should be taught at university from undergraduate level if not earlier" (Munir, 2022), however the courses being taught at universities don't give the necessary importance to these skills (KokoÇ & ErsÖZ, 2020).

In this paper we share preliminary findings from a larger research in progress on understanding professional skills development in undergraduate (UG) engineering students from an academic and industry perspective. We discuss findings from the academic perspective in this paper, particularly on the appropriate terminology to describe these skills and various development and assessment techniques that are or could be used in undergraduate engineering programs in the Australian context.

Research methodology

This paper aims to answer these two research questions, 'What are the different terms used to describe professional skills in engineering education?' and 'What are the different ways that can be used to develop and assess professional skills in engineering students?'. To answer these questions, a qualitative approach was adopted, specifically using 'phenomenography'. Phenomenography provides a methodological approach for exploring diverse perspectives, allowing us to understand how participants have encountered and interpreted different phenomena.

This approach aligns with the authentic realities of engineering practice, moving beyond abstract theoretical constructs to embrace the lived experiences of participants (Daly et al., 2008; Larsson & Holmström, 2007).

Data Collection

Semi-structured interviews were used as the data collection technique for which the participants were chosen using 'purposeful sampling' to help "understand the problem and the research question better"(Creswell, 2009). Three pilot interviews were conducted to test out the research questions and create a draft code book. This was followed by interviewing ten academics with experience of professional skill development and assessment within the engineering faculties in Australia. Academics included 50% male and 50% females, 5 from the Group of 8 (GO8) (A1, A2, A3, A9, A10), 3 from Australian Technology Network (ATN) (A4, A7, A8) and 2 from Regional Universities Network (RUN) (A5 , A6). Ethics approval for this study was obtained from University of Technology, Sydney (ETH23-8906) and consent was obtained from all identified participants. Semi structured interviews were conducted, face to face or online (via Zoom) and all interviews were recorded.

Data Analysis

Data analysis began by transcribing the interviews followed by a thorough reading to reflect on the overall meaning. This was followed by coding which was undertaken using NVivo. The coding was based on a 'structural coding' method where the code is a conceptual phrase that relates to a specific research question which also helps link the data to the research question in the early analysis stage (Creswell, 2009). The first round of coding was carried out on the three pilot interviews, which assisted in generating a set of codes as a starting point. After a careful analysis of the codes, ones with similar meanings were merged followed by grouping the codes under the research questions being addressed. This created a draft codebook which was used to code the ten interviews which are a part of the findings for this study. The codebook was updated as when new codes emerged.

Findings & Discussion

The Terminology

'Soft skills' is a term that is quite commonly used to describe the non-technical or professional skills and participants believe that the use of the word 'soft' to address these skills has a gendered connotation, exacerbating the gender issues already present in the profession. It tends to make students think of these skills as *simple* or easy and since "language can either replicate problems or effect change" (Berdanier, 2022), to teach the next generation the value of these skills, there is a need to use the right term.

> *If we refer to it as hard and soft, we're kind of saying, the hard skills are the ones that are challenging and technically rigorous, so you need to invest more time in them [Participant A4]*

One perspective was that 'non-technical' and 'technical skills' should not be considered separate, instead the non-technical skills should be looked at in a technical context, since they tend to vary by profession. A participant was of the view that the word 'soft' reinforces the belief that these skills don't have a knowledge component and are generic layperson's capabilities that you can learn by doing, emphasising that engineering practice consists of knowledge and skills in engineering science, engineering social science and engineering humanities and should be taught accordingly, as explained in the comment below:

> *Engineering practice is underpinned by engineering science, engineering social science and engineering humanities and all of those contribute to engineering practice knowledge and engineering practice skills [Participant A7]*

It was not only the term 'soft skills' that was identified as an issue. Reflecting on 'graduate qualities'

as the official terminology used by many universities when talking of ‘soft skills’, a participant called that ‘*problematic*’, saying that the ‘qualities’ we want undergraduates to develop, are the people who haven't graduated yet, so it is not appropriate to address them as such. The participant was of the view that rather than spending time and effort thinking about the terminology, it would be better to focus on the how, as is clear from the comment below:

> *To me it’s this academic rabbit hole we go down with everything, with overthinking terminology. I know what you mean by soft skills, everyone knows what you mean by soft skills [Participant A9]*

The alternate terms suggested by the participants in place of ‘soft skills’ were ‘professional skills’, ‘socio-technical skills’, ‘generic skills’, ‘human skills’, ‘interpersonal skills’, ‘social skills’, ‘engineering practice’, ‘transferable skills’, ‘essential skills’ and ‘work relevant skills’. There was no consensus on the alternate term, but majority of the academics chose ’professional skill’ as a preferred term.

Professional skill development

Professional skill development is a matter of changing mindsets, mindsets of the academics, students, and industry professional and to enable that, there is a need to have a discussion with industry about their needs, what's their responsibility versus the university sector’s responsibility in this regard. Munir (2022) has spoken of the role engineering education needs to play in balancing the three groups of stakeholders involved in this process. The stakeholders being, students who require a rewarding educational experience with the goal of securing jobs, employers who need high performing young graduates and academics who wish to excel at both teaching and research. There was consensus amongst the participants that the university has a major role to play in assisting students to develop their professional skills, and that implementation is key. A participant said that universities could better market their degrees if they made sure that the students’ professional skills were up to industry standard. Speaking of the bold graduate attributes statements every university embodies, participants highlighted that these statements “*don't and can't apply universally*” to all students and that while each student must have the opportunity to develop their professional skills, it’s important to acknowledge that each of these skills may or may not be their strength when they graduate. Another participant spoke of Blooms Taxonomy, saying that universities usually help students to develop their ability to understand and to remember, whereas the need is to get to the levels of ‘analyze, evaluate, create’.

The strategies that academics believe universities could implement, to help students develop professional skills were grouped into two categories, ‘within curriculum’ and ‘outside curriculum’.

Within Curriculum approach

1. **Whole of program approach**

   Participants unanimously believe that professional skill development needs a whole of program approach with support from the top, saying that these skills need be consistently implemented right from the start of the degree and all the way through, tying them with assessments. They need to be scaffolded with a strategically thought-out long-term vision with various touch points showing how these skills develop as the students’ progress through the course. Previous research has spoken about the lack of clarity on how these skills are developed and assessed even if they are embedded in the curriculum (Caeiro-Rodriguez et al., 2021). Participants said that there is a need to realise that this whole of program approach is a huge project needing buy-in from everyone and that in the interim, it would be ideal if individual academics could take accountability and reflect on their courses, thinking about how professional skills could be integrated into their courses. It is important to identify academics who are great communicators, engaging them to help students improve their professional skills, specifically communication skills. A participant said that it would be ideal to have professional skill development as a part of academic’s workload commitment.

   > *It takes a long time for change to happen, cultural change, I think it's gonna be a long term plan, like 7 to 10 years for it to have a clear vision, clear plan and then implement it right [Participant A10]*

2. **Experiential learning**

Participants believe that it is paramount for the universities to facilitate experiential learning environments for students to explore, fail and learn, while applying the skills and reflecting on them. Studios were suggested as an option because they are experiential, industry relevant and scalable. Participants also highlighted the effectiveness of project-based learning, as it can be as open or narrowly defined as required, giving students hands-on, authentic learning while also enabling students to experience and practice the cognitive and affective side of professional skills.

3. **Assessment reforms**

The extent to which an intervention influences the development of professional skills is a challenge and the real test is when these students get to the workplace, but reforming the way we assess can certainly help. As highlighted by the comment below, participants suggested that assessments should be designed such that the students' focus shifts from submitting an assignment or a final report to the process of undertaking a project and skills gained as a result.

> *Academics tend to get very focused on the correctness of the outcome of the project, whereas for most engineering projects in industry, the design we started with is not the design we finished with, I'm more concerned about how robust the process is coming to that solution [Participant A9]*

To guide a student's learning and receive feedback there should be defined milestones with a deliverable, designing a mechanism for students to reflect on those experiences and feed them forward into the next step. Participants also spoke of creating a benchmark as part of the assessment guidelines, which can help understand the current status of the student's professional skills, helping identify gaps and highlighting areas that need improvement.

Research has shown that even though final examinations are considered by academics as the most effective and equitable way of assessing knowledge and skills, they may not be effective to provide proper feedback and in assessing students' professional skills (Gratchev et al., 2023). The assessments should be designed in a way that they help students shift from "thinking and acting like students" to "thinking and acting like engineers"(Nolen et al., 2024). Echoing this, participants spoke of moving away from written exams to oral presentations and viva voces which can go a long way in helping students gain verbal communication and presentation skills, saying that it would be an added benefit if students were encouraged to deliver a commercial pitch for a project or even produce short videos reflecting on their learning in the subject.

4. **Team based projects**

Teamwork has shown to help students improve their communication skills, ability to complete tasks with others and navigate conflict over time. However, to facilitate effective teamwork, it is important to understand the mechanics of team setup, including mechanism for providing peer evaluation and/or feedback while also looking at assessment types (Rajabzadeh et al., 2022). It is important for students to practice these skills using team-based projects that reflect 'real-world' scenarios and participants identified that increased industry engagement can not only help source *real world* projects but also assist academics in designing meaningful *industry-inspired* projects. They highlighted that recent graduate engineers should be involved in delivering project-based subjects which can help reinforce the importance of these skills in the minds of students, as shown by comment below:

> *As soon as you have people who are non-engineers teaching the non-technical or the professional skills, you suggest to the students very clearly that they're not actually part of engineering, because otherwise we'd have the engineering academics or engineers teaching them [Participant A2]*

When designing a team project, academics should integrate systems thinking with teamwork, building on teamwork learning outcomes at different stages throughout the degree. Academics should ensure that team projects are complicated enough so that it is not possible for one or two students to complete them, thereby forcing students to work in teams. Projects should also have well defined role assignments and weekly milestones for effective learning. Participants

acknowledged that the biggest challenge for a university project is replicating the diversity of skills and experience that you find in a real team at a workplace. However, supporting students to create teams with a conscious mix rather than students teaming up with their friends, can enhance learning.

It is critical to slowly change the student mindset by moving away from providing students with well-defined projects to one where they are required to work on a broad project scope. This will enable them to learn problem definition while understanding stakeholder needs, helping them develop their critical thinking skills. Highlighting the importance of teaching the theory behind teamwork to help students make better decisions, a participant commented:

> *The behaviours and actions which evidence and research shows contribute to effective working together, to understand your strengths and weaknesses in doing that, and the influence of the organizational or the social culture on the choices you can make [Participant A7]*

To help academics implement teamwork in their subjects, participants spoke of the importance of having a well-defined rubric for assessing the various skills that contribute to effective teamwork, including peer evaluation, conflict management, leadership, communication, ethical behaviour and accountability. Use of peer-to-peer mentorship, where we have a first year mentored by a third year and second year mentored by a fourth-year student, was suggested as a way to help students develop professional skills.

5. **Additional approaches**

Taking inspiration from one of the world's top universities, a participant spoke of a university which has a block of time over a week, in which all students participate in a project that is intentionally designed to allow them to combine the technical competencies with socio-technical competencies, helping them understand the various types of engineering roles they could undertake and the value they hold as an engineer for their organization and for society. Another participant spoke of a model where 2 out of 4 subjects each semester, are used to teach essential technical content and the other half gets students to work on authentic real world industry projects involving teamwork, placements, or cadetships.

Outside curriculum approach

1. **Quality internships**

Research has shown that students develop professional skills by engaging in activities set in real-world contexts as that gives them a realistic understanding of what they might see in their work life. To support this, educators should encourage students to undertake these activities providing them with more opportunities, and industry practitioners on the other hand, should help by not only providing these internship opportunities but also by adopting an inclusive language toward professional skills(Holloway & Linvill, 2023). As a part of the accreditation process for engineering degrees in Australia, Engineers Australia requires all students to complete a 12 week full-time practical experience and participants believed that this is definitely an effective way to help students develop their professional skills but they highlighted that to make the most of this experience the universities should ensure that the students are being appropriately mentored and provided a safe environments to explore and learn in, and if possible be paid. While talking of a "gold standard" for an internship model, a participant spoke of the European universities where students do a 3-month internship every summer enabling them to have an extensive work experience at multiple companies, by the time they graduate.

2. **Extracurricular activities**

Researchers have looked into the effect of experiences outside of the classroom on the quality of a student's learning and have said that experiences like competitions, student teams and undergraduate research experiences, "reinforce and strengthen the knowledge they gain through engineering coursework" while also helping "enhance confidence and reinforcing academic and professional skills"(Cloutier et al., 2023). Activities involving students working on real projects, outside class, in multi-disciplinary teams, supported by academic and industry

mentors, can play a huge role in helping students develop professional skills, especially critical thinking and time management. Students usually are self-motivated to participate in these activities without the university offering any formal assessments as highlighted by the comment below. The participant said these activities could potentially be formalised, giving students credit for undertaking them, to encourage them even further.

> *We have students running around, teaching themselves and teaching each other professional and soft skills, and we don't even need to offer assessment for them to do it. They do it off their own backs because they're passionate and they love it [Participant A3]*

3. **Social media and AI**

   Social media and artificial intelligence (AI) in today's world have emerged as valuable assets providing a unique opportunity to gain valuable skills (Yousey, 2023). Participants spoke of using social media to help students gain professional skills, where students can be asked to create LinkedIn posts and share short project videos. Participants firmly advocated for the training of our young engineers to be proficient in ChatGPT and generative AI, enabling them to effectively use the tools to support their learning.

Professional skill assessment techniques

Participants unanimously believe that professional skills must be assessed as it helps motivate students to actively engage in the process, signifies the importance of these skills and helps provide feedback. In the case professional skill development is a learning outcome in a course, assessment helps ensure that the skills have indeed been taught and learnt. Research has shown that historically there are no "standardized approaches" for assessing professional skills at the undergraduate level (Green et al., 2024). A comment below, from a participant with extensive industry experience before joining academia, was interesting to note in this regard, highlighting a different perspective.

> *I am a bit torn on this, because, from an Academic perspective you have to assess the students, but from an industry perspective, it should just be a satisfactory or non-satisfactory, because a lot of these skills, are not measurable. [Participant A10]*

Talking of some assessment techniques, participants emphasised the need for having standardised rubrics to ensure equity. They spoke about improving assessment for teamwork, moving from assessing outcome to assessing process and exploring the possibility of having grades no marks which are discussed as under:

Assessing teamwork

> *Teamwork's the ultimate conundrum, it's probably the most important thing but also, one of the hardest things to teach and assess at uni [Participant A6]*

Researchers have spoken about considerations that need to be kept in mind when designing teamwork assessments including properly managing and forming teams, having individual students accountable for their contribution, and ensuring that the assignments help with team development while facilitating frequent and timely feedback (Cecilia Bastarrica et al., 2023). Participants highlighted the need for individualised assessment for teamwork, and spoke of using observation, peer feedback and reflection as various assessment strategies. Talking of **observation** as a strategy, they said that assessment for an individual's contribution to the team can be best done by observation, and highlighted that this may not be possible for universities with large student numbers which was interestingly countered by the comment below:

> *Every student's paying their fees, so how about you increase the number of staff on the subject so that you've got enough staff to be able to mark every student [Participant A2]*

For meaningful observation, students should be exposed to authentic conversation situations within the team, to enable them to think strategically. Teamwork assessment can be facilitated by designing simple easy to use rubrics, describing actions and behaviours that students are meant to be performing in the team, keeping in mind the various roles they play. A participant spoke about using contemporary technologies, for example observing students while they work in a Microsoft

teams' environment, to observe student behaviours and actions. Cecilia Bastarrica et al. (2023) report that peer assessment can have a positive effect on team performance rather than an academic evaluation, especially in the case of large student numbers with a caveat that there should either be an association with the grades or academic staff should supervise the process. This aligned with the view of our participants who spoke of using **peer feedback** to assess teamwork, which they said can be done in the form of a survey or a rating, encouraging students to provide formative feedback. They also highlighted that to ensure students take the activity seriously, it may be beneficial to assign small marks to the activity. Research has shown that "**reflective writing** supports conceptual learning" in the case it is included programme wide (Wilson-Fetrow et al., 2023). Speaking of the final report submitted towards the end of a team project, participants were of the view that besides including technical aspects, students should be asked to reflect on their learning, including the professional skills they have picked up, as shown by comment below:

> *Reflection helps students understand which of these soft skills they're good at, which ones they're not, and if they're conscious of it, they can decide whether they want to develop that or not, whether it's necessary, but we need to help them develop their consciousness of their skills [Participant A9]*

Assess process not outcome

Academics reflected on the importance of assessing the process rather than the outcome in a project-based subject. This is extremely relevant in today's world of generative AI, where it is almost impossible to measure the development of the capability or skills, in case the focus is on output and not on the process of learning. Participants acknowledged that assessing process is hard and may not be practical in a big university with large number of students. However, having academics observe and provide feedback to the students as they undergo the project can be highly beneficial in helping students develop professional skills. This process can be facilitated by having well laid out assessment rubric specifying that the purpose of a technical project is not just a good functional outcome, but the process is equally important.

Grades no marks

Almost all academic participants were of the view that not all assessments should be graded or given marks, and that we should assess a bit more qualitatively rather than quantitatively. A participant suggested the use of continual assessment methods for professional skills, to help students see their improvement, and if required, academics could intervene suggesting some remediation programs to the students, as shown by comment below:

> *Continual assessment where, each year there is a subject where we assess a skill and provide feedback and document that feedback, kind of like a doctor's report [Participant A4]*

A participant suggested that instead of marks, students could be marked off for being competent in the skill being assessed. This however would require the university to figure out the benchmark for deciding how competency would be established, while also ensuring that the assessment is carried out by academics or people from industry, who themselves are highly competent in the skill being assessed.

Conclusion

This paper has presented various ways that engineering academics perceive professional skills can be developed and assessed, however it is very important to note that not all strategies will work in all contexts. Agreeing on the importance of developing professional skills for graduates to be successful engineers, participants emphasised the importance of the terminology when it comes to addressing these skills. They also provided insights into various strategies that can be implemented within curriculum and outside curriculum to help with development and assessment of professional skills. As the next step we will be interviewing industry professionals to understand their perspective, to be able to compare and contrast the findings. However, it is clear from the findings that helping students develop professional skills *is indeed a balancing act,* where students, employers and academics have a very important role to play.

References

Ballesteros Sánchez, L., Ortiz Marcos, I., Rodríguez Rivero, R., & Juan Ruiz, J. (2017). Project Management Training: An Integrative Approach for Strengthening the Soft Skills of Engineering Students. *International Journal of Engineering Education*, *33*(6(A)), 1912-1926.

Berdanier, C. G. P. (2022). A hard stop to the term "soft skills." *Journal of Engineering Education 111*(1), 14-18. https://doi.org/https://doi.org/10.1002/jee.20442

Buckley, J., Trevelyan, J., & Winberg, C. (2021). Perspectives on engineering education from the world of practice. *European Journal of Engineering Education*, *47*(1), 1-7. https://doi.org/10.1080/03043797.2021.2000694

Caeiro-Rodriguez, M., Manso-Vazquez, M., Mikic-Fonte, F. A., Llamas-Nistal, M., Fernandez-Iglesias, M. J., Tsalapatas, H., Heidmann, O., De Carvalho, C. V., Jesmin, T., Terasmaa, J., & Sorensen, L. T. (2021). Teaching Soft Skills in Engineering Education: An European Perspective. *IEEE Access*, *9*, 29222-29242. https://doi.org/10.1109/access.2021.3059516

Cecilia Bastarrica, M., Gutierrez, F. J., Marques, M., & Perovich, D. (2023). On the Impact of Grading on Teamwork Quality in a Software Engineering Capstone Course [Article]. *IEEE Access*, *11*, 36492-36503. https://doi.org/10.1109/ACCESS.2023.3265302

Cloutier, A. M., Matusovich, H. M., Geary, C., & Huggins, N. C. (2023). Measuring the Impact of Extra-/Co-Curricular Participation on Professional Formation of Engineers. ASEE Annual Conference and Exposition, Conference Proceedings,

Creswell, J. W. (2009). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications. https://books.google.com.au/books?id=s4ViswEACAAJ

Daly, S., Mann, L., & Adams, R. (2008). A new direction for engineering education research: Unique phenomenographic results that impact big picture understandings. Proceedings of the 2008 AaaE Conference,

Gratchev, I., Howell, S., & Stegen, S. (2023). Academics' perception of final examinations in engineering education [Article]. *Australasian Journal of Engineering Education*. https://doi.org/10.1080/22054952.2023.2284484

Green, M., Knizley, A., & Strawderman, L. (2024). Perceptions of the Importance of Interpersonal Skills by Engineers, Students, and Faculty [Article]. *International Journal of Engineering Education*, *40*(1), 116-125. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85184522229&partnerID=40&md5=4b7b017bff209e03a05b5a767a214d58

Holloway, E., & Linvill, J. S. (2023). Changing the Conversation Surrounding Students' Professional Skills: Making the Case for the Importance of Professional Skills, and More Inclusive Language. ASEE Annual Conference and Exposition, Conference Proceedings,

KokoÇ, M., & ErsÖZ, S. (2020). T-TİPİ MÜHENDİS: HASSAS BECERİLERDEN OLUŞAN YATAY BİLEŞEN [T-shaped engineer: Horizontal component comprising of soft skills]. *Endüstri Mühendisliği Dergisi*, *31*(2), 180-197. https://doi.org/https://doi.org/10.46465/endustrimuhendisligi.728405

Larsson, J., & Holmström, I. (2007). Phenomenographic or phenomenological analysis: Does it matter? Examples from a study on anaesthesiologists' work. *International Journal of Qualitative Studies on Health and well-being*, *2*(1), 55-64.

Lee, P., Crosthwaite, C., Reidsema, C., Burnett, I., Foley, B., Hargreaves, D., King, R., Lamborn, J., Symes, M., & Wilson, J. (2022). Preparing Engineers for 2035: Transforming Australia's Engineering Education for Emerging Roles and Expectations. In *Lecture Notes in Educational Technology* (pp. 29-52). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/978-981-16-9812-5_2

Munir, F. (2022). More than technical experts: Engineering professionals' perspectives on the role of soft skills in their practice [Article]. *Industry and Higher Education*, *36*(3), 294-305. https://doi.org/10.1177/09504222211034725

Nolen, S. B., Michor, E. L., & Koretsky, M. D. (2024). Engineers, figuring it out: Collaborative learning in cultural worlds [Article]. *Journal of Engineering Education*, *113*(1), 164-194. https://doi.org/10.1002/jee.20576

Rajabzadeh, A. R., Long, J., Saini, G., & Zeadin, M. (2022). Engineering Student Experiences of Group Work. *Education Sciences*, *12*(5), 288. https://doi.org/https://doi.org/10.3390/educsci12050288

Wilson-Fetrow, M., Svihla, V., Chi, E., Hubka, C., & Chen, Y. (2023). Engineering Students' Writing Perceptions Impact Their Conceptual Learning [Article]. *IEEE Transactions on Professional Communication*, *66*(2), 186-201. https://doi.org/10.1109/TPC.2023.3251159

Yousey, P. (2023). *Using Generative AI To Enhance Professional Development*. Training Industry, Inc. . https://trainingindustry.com/articles/professional-development/using-generative-ai-to-enhance-professional-development/