

Essential Non-Technical Skills for Software Engineering and Engineering Science Graduates: A Case Study from North Cyprus

Lawrence A. Farinola^{1*}, Tooichi P. Farinola²

¹ Department of Software Engineering, Faculty of Architecture and Engineering,
Rauf Denktas University, Mersin 10 via TÜRKIYE

² Department of Computer and Instructional Technologies Education, Faculty of Education,
Eastern Mediterranean University, Mersin 10 via TÜRKIYE

*Corresponding Author: lawrence.farinola@rdu.edu.tr
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Abstract

This quantitative descriptive study examines key non-technical (soft) skills influencing the employability of software engineering and engineering sciences graduates in North Cyprus. A total of 50 stakeholders—comprising university lecturers, industry experts, postgraduate students, recent graduates, and job seekers—participated in a structured survey featuring 57 items across nine skill categories. Quantitative analysis using descriptive statistics (means, frequencies, standard deviations) revealed that skills such as contextual problem-solving, written communication, patience, leadership, brainstorming, professionalism, responsibility, planning, and empathy received mean scores above 3.5 on a 5-point scale, demonstrating strong perceived importance in recruitment processes. Findings underscore a notable gap in current engineering curricula regarding non-technical skills training. To address this, we advocate for the systematic integration of soft-skills development into university programs and recommend enhanced partnerships between academia and industry to improve workforce readiness.

1. Introduction

Higher education institutions are not solely focused on producing graduates with narrow technical specializations, but rather aim to equip students with employability skills that align with labor market demands across various industries (Mohd et al., 2018; Finch et al., 2013; Andrews & Higson, 2008). In the fields of software engineering and engineering sciences, there remains a predominant emphasis on technical competencies, often at the expense of essential non-technical skills (which is also referred to as soft skills). As global economies shift toward service-oriented structures, there is an increasing reliance on professionals—such as software engineers—who not only possess technical expertise but also demonstrate strong interpersonal and problem-solving abilities. In this context, soft skills such as effective communication, adaptability, and critical thinking have become indispensable for professional success.

Software engineers play a vital role in national development, especially in today's complex, multidisciplinary work environments. Technical knowledge alone is no longer enough; engineers must collaborate across fields, requiring strong non-technical skills (Tien & Fu, 2020). To stay employable, graduates need to understand and develop these soft skills as part of their academic training.

With rapid technological growth, the global demand for engineers has risen—especially in IT sectors that often prioritize soft skills more than traditional firms. However, many employers remain dissatisfied with graduates' non-technical abilities (Jackson, 2016; Yorke, 2006). This gap highlights the urgent need for universities to align their programs with workplace expectations and better prepare students for the modern job market.

This study focuses on identifying the essential non-technical skills—both adaptive and functional—required by software engineering graduates to succeed in modern workplaces. Non-technical skills, encompassing interpersonal abilities, emotional intelligence, and workplace behaviors, are not typically measured through academic performance but are critical for team effectiveness and job performance. In software development, which is inherently collaborative, the success of a project is strongly influenced by the team's ability to communicate, coordinate, and resolve conflicts.

As the importance of soft skills in the software engineering industry continues to grow, a noticeable skills gap has emerged between the competencies of recent graduates and the expectations of employers. While a growing body of research has explored this gap, few studies have directly compared the perspectives of industry professionals with the non-technical competencies emphasized in higher education curricula.

While previous studies have explored graduate employability from employers' or educators' perspectives, few have critically examined how the soft-skill components of existing university curricula align with the competencies valued by industry. This study, therefore, also offers an indirect reflection on current curricular frameworks in North Cyprus, identifying areas where academic training and market expectations diverge.

Therefore, the primary aim of this study is to explore the perceptions of industry professionals regarding the non-technical skills considered essential for recruitment among graduates of software engineering, information technology, and engineering education in North Cyprus. Specifically, it seeks to identify the soft skills most highly valued in the hiring process and to offer insights that can guide curriculum development and industry-academia collaboration. This investigation is grounded in the central research question: *What non-technical skills are considered important by professionals as recruitment prerequisites among graduates of software engineering and engineering disciplines in North Cyprus?*

This study contributes empirical evidence from North Cyprus to the growing discourse on employability skills in engineering education, offering localized insights that may inform curriculum design across comparable developing contexts. This study provides localized evidence that can guide policy and curriculum reforms aimed at enhancing graduate employability in developing higher education contexts.

2. Literature Review

In today's competitive labor market, employers increasingly prioritize candidates with strong employability skills in addition to technical qualifications (Pushpa & Kranti, 2021; Mohd et al., 2018). Employability skills refer to the ability of graduates to adapt and apply both personal and academic competencies to produce tangible outcomes, making them suitable for integration into the workforce (Mohd et al., 2018). While software engineering (SE) has traditionally been regarded as a highly technical discipline—requiring proficiency in programming, complex system analysis, and software frameworks—technical competence alone is no longer sufficient for success in the field.

Modern employers expect software engineers to possess a combination of technical expertise and non-technical, interpersonal competencies. These non-technical skills include responsibility, self-confidence, emotional self-control, social skills, honesty, integrity, adaptability, flexibility, teamwork, punctuality, efficiency, self-direction, strong work ethics, and professionalism (Pushpa & Kranti, 2021; Robles, 2012; Schulz, 2008; Jameson, 2019). As such, the ability to interact effectively, manage time, and function collaboratively in a team setting has become essential in a service-driven and rapidly evolving economy.

Contemporary industries seek graduates with a well-rounded profile—those who not only demonstrate technical proficiency but also embody essential soft skills such as critical thinking, decision-making, creative problem-solving, and positive attitudes. Candidates with entrepreneurial mindsets—who can assess situations, identify business opportunities, and contribute to strategic development—are highly valued (Azmi et al., 2018). Accordingly, there is a growing consensus that employability skills must be embedded across the entire curriculum, not isolated to a single course or module. Graduates with robust non-technical competencies reduce employers' need for extensive training and onboarding, ultimately saving time and costs (Lee & Lee, 2015; Jauhari & Singh, 2013).

The widening gap between graduate capabilities and labor market expectations is often attributed to insufficient emphasis on soft skills in higher education. Employers consistently report that many graduates lack essential competencies such as adaptability, teamwork, effective communication, and critical and creative thinking (Omer & Abdalla, 2020; Ismail & Daud, 2021; Hossain & Hossain, 2019). Addressing this gap requires universities to reform educational strategies and align academic outputs with industry demands.

Employability skills are among the most frequently discussed workforce development themes in current scholarship. These skills have been broadly defined as the core competencies necessary not only to secure employment but also to thrive, grow, and contribute meaningfully across diverse occupations and industries (Ahmad & Ali, 2019; Bridgstock, 2009). Beyond technical ability, employability encompasses non-technical and occupational skills that empower graduates to climb professional hierarchies, support organizational growth, and stay resilient in times of economic and technological change (Yorke & Knight, 2004; Rae, 2007).

Given the rapid pace of technological advancement and economic shifts, employers face increasing pressure to recruit individuals who can quickly adapt to changing workplace needs. This highlights the urgent responsibility of educational institutions to equip graduates with the flexibility, knowledge, and learning agility required to navigate such challenges (Harvey, 2001; Bennett, 2002). Graduates' capacity to acquire, unlearn, and relearn knowledge plays a crucial role in sustaining employability and ensuring long-term career success (Finch et al., 2013).

The importance of non-technical skills is reinforced by global industry observations. For instance, studies in Malaysia report that although technical graduates meet core technical expectations, employers are often dissatisfied with their critical thinking, communication, problem-solving, and entrepreneurial skills (Mustapha, 2015). Similar concerns have been raised in Japan, where engineering graduates have been criticized for a lack of initiative and independent problem-solving ability (Tanaka, 2018). These findings suggest a universal demand for integrating soft skills into technical education to produce more employable, industry-ready graduates.

However, there is limited empirical evidence addressing these issues within the context of Northern Cyprus or neighboring Mediterranean regions, where engineering education is expanding rapidly but often follows imported curricular models. Recent studies also reinforce the importance of non-technical competencies such as communication, collaboration, and problem-solving in engineering and IT education (Al-Ghalayini & Al-Wadi, 2023; Acosta-Vargas et al., 2024).

Recent research continues to highlight the significance of integrating non-technical skills into engineering and IT curricula. For instance, Al-Ghalayini and Al-Wadi (2023) emphasized that enhancing communication and teamwork skills through outcome-based education frameworks improves graduate employability. Similarly, Acosta-Vargas, Solano, and Luján-Mora (2024) conducted a systematic review showing that soft skills such as collaboration, adaptability, and problem-solving are increasingly essential for success in technology-related professions.

3. Research Methodology

3.1 Research Design

This study adopted a quantitative descriptive survey design, which is suitable for gathering numeric data to describe the perceptions of multiple stakeholder groups regarding the importance of non-technical skills among engineering graduates. The design was selected because it allows for systematic collection and analysis of responses using structured instruments and statistical techniques to identify patterns and relationships within the data. The approach emphasizes objective measurement, ensuring that conclusions drawn are based on quantifiable evidence rather than subjective interpretation.

3.2 Population and Sampling

The target population consisted of individuals directly or indirectly involved in software engineering and related engineering education in North Cyprus, including university lecturers, postgraduate students, recent graduates, job seekers, and industry professionals. The estimated population of interest across the selected universities and technology firms was approximately 150 individuals.

A purposive sampling technique was employed to ensure inclusion of participants with relevant academic or professional experience in engineering and IT fields. From this population, 50 participants were selected, representing a cross-section of academia (30%), industry professionals (30%), and students or recent graduates (40%).

3.3 Sample Characteristics

Of the 50 participants, 32 were male (64%) and 18 female (36%), with ages ranging from 23 to 58 years (mean age = 34.2 years). Participants held varied academic and professional positions—lecturers and instructors ($n = 15$), postgraduate students ($n = 10$), recent graduates ($n = 12$), job applicants ($n = 6$), and industry practitioners ($n = 7$). Approximately 80% of respondents reported over two years of experience in engineering-related environments, providing a credible and informed basis for evaluating employability-related skills.

3.4 Research Instrument

Data were collected using a structured questionnaire developed and refined based on previous studies (Robles, 2012; Pushpa & Kranti, 2021; Mohd et al., 2018). The instrument consisted of 57 items grouped under nine (9) core constructs of non-technical skills:

1. Communication Skills – 8 items
2. Interpersonal Skills – 6 items
3. Problem-Solving Skills – 8 items
4. Work Ethic – 5 items
5. Organizational Skills – 6 items
6. Emotional Intelligence – 6 items
7. Situational Awareness – 5 items
8. Decision-Making Skills – 6 items
9. Stress and Fatigue Management – 7 items

Each item was rated on a five-point Likert scale ranging from 1 = *Strongly Disagree* to 5 = *Strongly Agree*, reflecting the perceived importance of each skill in professional engineering contexts.

3.5 Validity and Reliability

The content validity of the questionnaire was established through expert review by two senior academics and one industry practitioner specializing in software engineering and employability research. Their feedback was used to refine ambiguous items and ensure alignment with the study objectives.

A pilot study involving five respondents (not included in the main study) was conducted to assess clarity and item consistency. The construct validity was examined through factor analysis, confirming the internal coherence of the nine skill domains.

Reliability was assessed using Cronbach's alpha, which yielded an overall coefficient of 0.89, indicating high internal consistency. Subscale alphas ranged from 0.78 to 0.91, demonstrating that each construct reliably measured the intended concept.

3.6 Data Collection Procedure

Data collection was conducted over a four-week period in April 2024. Questionnaires were distributed both electronically (via Google Forms) and in printed form for respondents with limited internet access. Participants were informed of the study's purpose, confidentiality assurance, and voluntary participation policy. Responses were anonymized before analysis to ensure ethical compliance.

3.7 Data Analysis Plan

Collected data were coded and analyzed using the Statistical Package for the Social Sciences (SPSS) version 27. Descriptive statistical techniques—such as mean, standard deviation, and frequency distribution—were used to summarize respondents' ratings across the nine skill constructs.

To assess differences in perceptions among stakeholder groups (academia, industry, and students), independent-sample t-tests and one-way ANOVA were initially explored but omitted due to the small sample size, limiting inferential power. Consequently, results are presented descriptively to highlight the relative importance and ranking of each non-technical skill category.

The findings from this analysis are presented in Section 4, accompanied by a ranked table and bar chart illustrating the most valued non-technical skills for software engineering and engineering sciences graduates in North Cyprus.

4. Findings and Discussion

Table 1 below summarizes the analyzed data, showing that all 57 non-technical skills assessed in this study have mean scores above 3.50. This indicates a strong consensus that these skills are very important for the recruitment of software engineering and engineering sciences graduates in Northern Cyprus. For brevity, only the top ten skills with the highest frequencies and mean scores are presented. Minor variations in the number of respondents (N) per skill reflect non-responses or omitted items in the questionnaire.

Figure 1 presents a horizontal bar chart illustrating the average importance scores of the top ten non-technical skills identified as essential for software engineering graduates. Each bar represents the mean score given by survey respondents or evaluators, providing insight into which soft skills are prioritized within the field. Among these, *responsibility* stands out with the highest mean score, indicating it is considered the most critical attribute

for graduates to possess. In contrast, *patience* holds the lowest mean score among the top ten, suggesting it is valued less comparatively but still recognized as an important skill. The chart effectively visualizes the relative emphasis placed on various interpersonal and professional abilities that complement technical expertise in software engineering roles.

Table 1 Mean scores and standard deviations of top non-technical skills

Category	Skill	N	Mean	SD	Remark
Communication	Written Communications	41	4.14	0.8809	Prioritized
Interpersonal	Leadership	39	4.04	0.8320	Prioritized
Interpersonal	Patience	39	4.00	0.8571	Prioritized
Problem Solving	Problem Sensitivity/Contextually	39	4.06	0.8901	Prioritized
Problem Solving	Brainstorming skills	39	4.22	0.9538	Prioritized
Problem Solving	Critical thinking skills	40	4.04	0.9026	Prioritized
Work Ethic	Professionalism	40	4.06	0.8184	Prioritized
Work Ethic	Responsibility	42	4.26	0.9649	Prioritized
Organization	Planning skills	41	4.20	0.8893	Prioritized
Emotional Intelligence	Empathy	43	4.12	0.8485	Prioritized

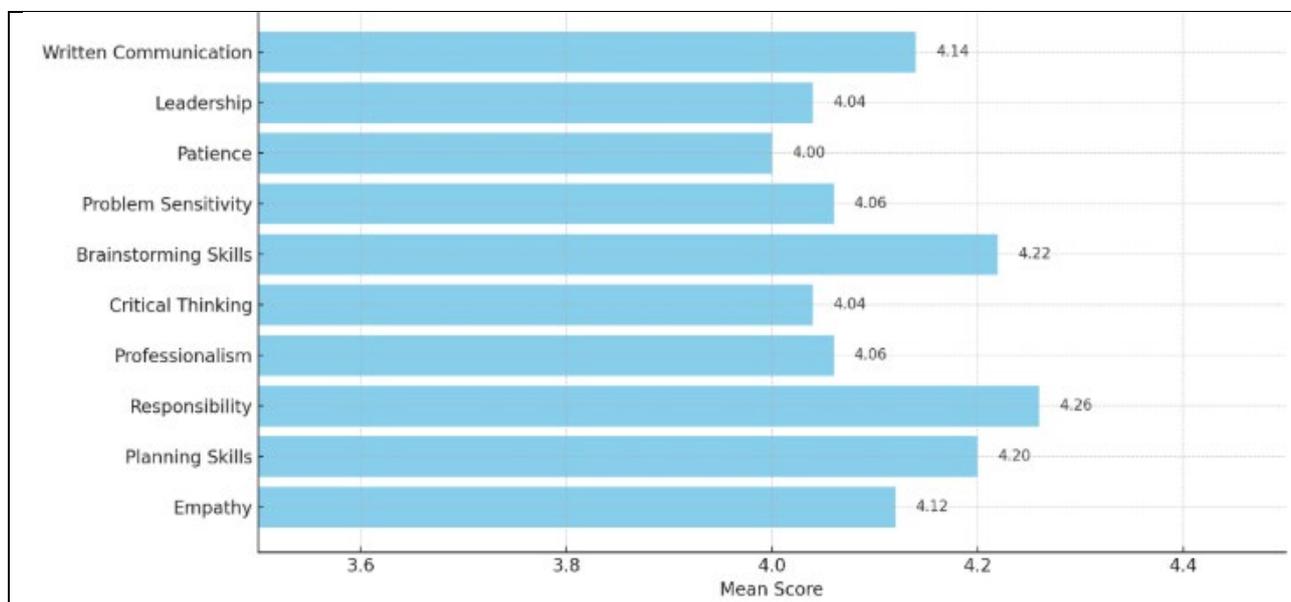


Fig. 1 Mean scores to top non-technical skills for software engineering graduates

In alignment with existing literature, this study confirms that non-technical skills are highly valued and critical for graduates in software engineering and related engineering education programs in Northern Cyprus. While software engineering has been recognized as a distinct discipline by some researchers, there remains a need for more focused attention on its curricula, especially regarding non-technical competencies.

A brief review of course outlines from selected engineering programs in North Cyprus reveals that, although technical modules such as software design, algorithms, and systems architecture are extensively covered, explicit instruction in non-technical competencies remains limited. Courses rarely include formal training in teamwork, leadership, or communication beyond final-year projects. The strong emphasis placed by industry participants on responsibility, professionalism, and empathy in this study suggests that these attributes are underrepresented in current curricula. Incorporating structured activities—such as project-based teamwork assessments, communication workshops, and reflective learning components—could strengthen the integration of these essential soft skills within engineering education.

These findings corroborate prior international research that emphasizes the role of interpersonal and organizational competencies in engineering employability (Mohd et al., 2018; Bakare et al., 2020; Inga & Deniss, 2021), confirming that local employer expectations in North Cyprus are consistent with global trends.

The review of related research revealed six major categories frequently emphasized by employers within engineering science education: communication skills, negotiation skills, team spirit, innovation, self-awareness, and entrepreneurial skills (Pushpa & Kranti, 2021; Bakare et al., 2020; Ahmad & Ali, 2019; Bakare et al., 2022). These findings reinforce the importance of non-technical skills as essential factors for graduate employability.

This study highlights a set of non-technical skills that are especially valued by employers hiring software engineering and engineering science graduates in Northern Cyprus. Among the most important are:

- Written communication, which supports clear expression of technical ideas
- Leadership and patience, reflecting the interpersonal abilities needed to manage teams and collaborate effectively
- Problem sensitivity, brainstorming, and critical thinking, which are central to solving complex real-world challenges
- Professionalism and responsibility, core aspects of a strong work ethic
- Planning skills, important for task and time management
- Empathy, a key part of emotional intelligence and understanding user needs

Graduates who demonstrate this blend of professional and non-technical skills tend to be more competitive in the job market (Bakare et al., 2020). These findings are in line with existing literature, which increasingly points to employers placing greater emphasis on soft skills—sometimes even more than technical expertise (Mohd et al., 2018; Mohamad et al., 2020; Inga & Deniss, 2021).

Interestingly, Pushpa and Kranti (2021) likened non-technical skills in engineering to the role of salt in food—essential yet often overlooked—highlighting how fundamental they are for success. Similarly, Bakare et al. (2022) argue that these soft skills don't just complement technical training; they elevate a graduate's ability to adapt, collaborate, and contribute meaningfully in professional environments.

5. Conclusion

This study underscores the important role of soft skills—such as teamwork, communication, empathy, problem-solving, and responsibility—in shaping the employability of engineering and software engineering graduates. These skills are not optional; they are highly valued by employers.

The findings highlight the need for early engagement between students and employers to align expectations. Universities must adapt curricula to reflect workplace realities, while graduates should take initiative to develop the soft skills needed for career success.

To bridge the gap between education and employment, two key strategies are recommended:

1. Stronger University–Industry Collaboration to keep academic programs aligned with evolving industry needs.
2. Active Graduate Involvement in understanding and meeting employer expectations beyond technical knowledge.

Practically, universities can embed soft-skill learning outcomes into accreditation criteria, design interdisciplinary capstone projects requiring teamwork and leadership, and organize industry mentorship programs to expose students to real-world professional communication contexts.

Beyond the present scope, future research should employ a mixed-methods design—combining surveys with interviews or focus-group discussions—to gain deeper insight into how universities and employers perceive and assess these competencies. Expanding the sample to include multiple institutions and comparing different engineering disciplines (e.g., mechanical, electrical, civil, and computer engineering) would enrich understanding of how non-technical skills vary across fields. Longitudinal studies tracking graduates' career progress could also reveal how such competencies evolve and contribute to long-term employability outcomes.

In conclusion, thriving in today's engineering landscape requires more than technical expertise—it demands a balanced skillset, shaped by collaboration between academia, industry, and graduates. Integrating soft skills development into accreditation frameworks can help ensure that future engineers are not only technically competent but also socially and professionally agile.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Author L, Author T; **data collection:** Author T; **analysis and interpretation of results:** Author L; **draft manuscript preparation:** Author L, Author T. All authors reviewed the results and approved the final version of the manuscript.

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