EXACTA Engenharia de Produção eISSN 1983-9308

Editor: Dr. Luiz Fernando Rodrigues Pinto,
Universidade Nove de Julho, UNINOVE, São Paulo, SP, Brasil
Submissões para este periódico

Exploring the perspectives of undergraduate students, graduates and managers on the skills learned in an industrial engineering course

Lucas Trajano de Freitas Almeida e Marcele Elisa Fontana

Federal University of Pernambuco, Recife, PE, Brazil

OPEN ACCESS

Notas dos Autores
Os autores declaram que não há conflitos de interesses.
Autor correspondente: Marcele Elisa Fontana - marcele.elisa@ufpe.br
Financiamento: CAPES - Financing Code 001 / Universidade Federal de Pernambuco (UFPE) - Edital pesquisador PROPG nº 06/2022

Recebido: 03 jun. 2024
Versão do autor aceita publicada online: 15 out. 2024
Publicado online: 03 fev. 2025

Como citar esse artigo - American Psychological Association (APA):

Almeida, L. T. F., & Fontana, M. E. (2025, artigo aceito online). Exploring the perspectives of undergraduate students, graduates and managers on the skills learned in an industrial engineering course. *Exacta*, artigo aceito online. https://doi.org/10.5585/2025.26785

Abstract

The current job market has increasingly required behavioural skills from engineering professionals when compared to technical skills. However, Higher Education Institutions often do not prepare undergraduates for the real job market requirements. This study set out to analyse the gap between the skills developed during higher education (HE) in industrial engineering and those required by the labour market. Two self-administration questionnaires were developed and applied to: (1) undergraduates and graduates of an industrial engineering course located in Pernambuco, Brazil, and (2) Company managers from the same location. The data were analysed in order to answer six hypotheses research developed based on the literature review. The results confirm there is a gap between the skills developed by the

university and the skills valued by companies. This work contributes to the discussion about the quality of HE in industrial engineering, mainly in developing countries like Brazil.

Keywords: higher education, business, soft skills, hard skills

Resumo

Explorando as perspectivas de graduandos, graduados e gestores sobre as habilidades aprendidas em um curso de engenharia de produção

O mercado de trabalho atual tem exigido cada vez mais competências comportamentais dos profissionais de engenharia quando comparadas às competências técnicas. No entanto, as Instituições de Ensino Superior muitas vezes não preparam os graduandos para as reais exigências do mercado de trabalho. Este estudo se propôs analisar a lacuna entre as competências desenvolvidas durante o ensino superior (ES) em engenharia de produção e aquelas exigidas pelo mercado de trabalho. Para isso, dois questionários de autoadministração foram elaborados e aplicados a: (1) alunos e ex-alunos de um curso de engenharia de produção localizado em Pernambuco, Brasil; e (2) gestores de empresas da mesma localidade. Os dados foram analisados a fim de responder a seis hipóteses de pesquisa desenvolvidas com base nos conceitos encontrados na literatura. Os resultados confirmam que existe uma lacuna entre as competências desenvolvidas pela universidade e as competências valorizadas pelas empresas. Este trabalho contribui para a discussão sobre a qualidade do ES em engenharia de produção, principalmente em países em desenvolvimento como o Brasil.

Palavras-chave: ensino superior, empresas, habilidades interpessoais, habilidades técnicas

1 Introduction

The backdrop of competition in the market has caused social, individual, organizational changes and in several other spheres throughout the history of mankind. In recent years, the main changes are due to what is called the 4th Industrial Revolution (I4.0), which has generated factors such as the era of advanced robotics, the development of artificial intelligence technologies, automation and machine learning (Abelha et al., 2020; Sun et al., 2023). Furthermore, in 2020, the pandemic disrupted the labour market and business models around the world, causing changes that have never been seen before (Mckinsey & Company, 2021), accelerating the arrival of the “future of work” (World Economic Forum - WEF, 2020). Thus, new and urgent skills are emerging in the labour market (Gouda, 2022).

Skills lead to organizational efficiency by producing ideas and inventing technologies and capability that increase productivity and create demand, resulting in economic growth (Baird and Parayitam, 2019). However, one of the problems pointed out by companies is the shortage of duly qualified professionals to occupy posts (Chryssolouris et al., 2013; Helleno et al., 2013). "Being work-ready implies that graduates are able to transfer their learning from higher education institutions (HEIs) into the workplace" (Bredenkamp et al., 2023).

However, HEIs are often criticized for not preparing graduates for the real contexts that involve their professional practice (Abelha et al., 2020). Companies recognize the importance of the professionalizing contents in undergraduate courses, but point out deficiencies in the training of these professionals in relation to the skills needed in the job market (Andreas 2018; dos Santos and Simon, 2018). Thus, it is important for academics to think about ways to develop these skills and increase the employability of recent graduates, as competencies and employability are interrelated concepts, since competition for jobs requires that the best candidates be evaluated for their skills and competencies acquired through academic training and the individual's personal experiences (Abelha et al., 2020; Baird and Parayitam, 2019; García-Aracil et al., 2021). Thus, the main motivation for this research was the belief that nowadays soft skills are more valued than hard skills in the daily operations of a company, associated with the hypothesis that current and traditional higher education is not meeting this demand.

Therefore, this study set out to analyse the gap between the skills developed during higher education in industrial engineering course and those required by the labour market. For this purpose, a theoretical model was developed, based on a literature review, considering six hypotheses. The model was tested using field research data through two self-administered questionnaires: (1) undergraduates and graduates of an industrial engineering course at the Agreste Academic Center (CAA) of the Federal University of Pernambuco (UFPE), and (2) Company managers from the same location. The data were statistically analysed for obtaining a descriptive analysis and outcomes of the hypotheses test.

Although this work is limited to the study of one undergraduate course, it reveals generalist results. The industrial engineering course was chosen because it represents a complex area that has an impact on almost all other professions (Munir, 2022). This study, in addition to offering a view of the market, contributes by including the perceptions of engineering students about the skills developed during their training, and can provide inputs for universities to reorganize their activities in an assertive way.

This study provides new insights into the change in the standard of skills that students need to secure before looking for a job and the importance of proper interaction and collaboration between companies and universities. Moreover, this work stimulates dialogical interaction and the exchange of knowledge between educational institutions and private

companies in the process of developing skills during academics in higher education in engineering, providing society with future professionals who meet its emerging needs. For all these reasons, this study can contribute to the Sustainable Development Goals (SDG) (https://odsbrasil.gov.br/), especially SDG4 that deals with quality education.

In addition to this introduction, this article is organized into four other sections: Section 2 presents fundamental concepts for the research and the formulation of hypotheses; Section 3 describes the methodology used; Section 4 summarizes the results and presents the discussion; and, finally, Section 5 offers final considerations.

2 Literature overview and hypotheses

2.1 Skills for the job market

One way to differentiate skills is according to their applicability in the labour market in: (i) general or transversal skills (soft skills), and (ii) specific or technical skills (hard skills) (Rebele and Pierre, 2019; Sá and Serpa, 2018). These skills lead to future professionals acquiring skills to work with society and organizations (Alves et al., 2016; Oliveira and Almeida Jr., 2015).

Soft skills are classified as general skills, not technical ones, as they are required for all types of work, being transversal and transferable to different contexts (Munir, 2022; Sá and Serpa, 2018). These skills are personal attributes directly linked to a professional's mental aptitudes, i.e., the skills acquired throughout life and experiences, whether professional or not, that improve an individual's interactions, work performance and career prospects (Matsuka and Mihail, 2016; Sharma, 2018; Tang, 2020). While hard skills are those skills considered technical and specific, as they are applicable only in the environment for which they were developed, i.e., they show the professional's "know-how" related to the nature of their training, measured through certificates or diplomas (Matsuka and Mihail, 2016; Sá and Serpa, 2018).

In addition to technical skills, workers of the future will also need strong critical thinking skills to effectively understand and leverage human-machine interactions (Chrisinger, 2019). In this context of transformations, the World Economic Forum (WEF, 2020), in its report *'The future of Jobs'*, highlighted 15 skills for 2025. Furthermore, due to the research locus, it is important to understand the professional profile expected for an industrial engineer, through the skills listed by Brazilian Association of Industrial Engineering (ABEPRO). Table 1 summarizes the skills studied and categorizes them into hard and soft.

Table 1

Skills analysed in this study

Code	Description	WEF	ABEPRO	Category
S1	Analytical thinking and innovation	X		Soft
S2	Active learning and learning strategies	X	X	Soft
S3	Solving complex problems	X	X	Hard
S4	Critical thinking and analysis	X	X	Hard
S5	Creativity, originality and initiative	X	X	Soft
S6	Leadership and social influence	X	X	Soft
S7	Use, monitoring and control of technology	X	X	Hard
S8	Mastery of computational techniques	X	X	Hard
S9	Resilience, tolerance of stress and flexibility	X	X	Soft
S10	Reasoning, problem solving and ideation	X	X	Hard
S11	Emotional intelligence	X	X	Soft
S12	Troubleshooting and User/Customer Experience	X	X	Soft
S13	Orientation towards serving (actively look for ways to help others)	X		Soft
S14	Systems analysis and evaluation	X	X	Hard
S15	Persuasion and Negotiation	X	X	Soft
S16	Knowledge of a foreign language		X	Hard
S17	Knowledge of legislation		X	Hard

Although hard skills are still important, WEF studies (2020) show an appreciation and growing demand for soft skills in the job market. Lack of people skills is now one of the main reasons for dismissing employees (Ismail et al., 2011). In this context, the following hypothesis arises:

H1: Soft skills are more important than hard skills in the everyday operations in a company.

2.2 Skills learned at university

Higher Education should provide students with the knowledge and skills necessary for professional development (Franco-Ángel et al., 2022). Traditionally, Higher Education Institutions (HEIs) are required to provide their students with strong technical-scientific training (hard skills), but these specific skills are devalued when the environment changes, as they do not apply to other professional contexts (Sá and Serpa, 2018; Succi and Wieandt, 2019). However, as the emphasis increases on developing interpersonal skills, there should be less emphasis on technical issues given constraints on class time (Rebele and Pierre, 2019). Thus, HEIs need to identify ways to develop the skills needed.

In the literature, research points out that extracurricular activities create an environment conducive to the development of skills through new experiences that complement the basic curriculum of the disciplines, giving the student the opportunity to experience the profession even during an undergraduate course (Peres et al., 2007). Extracurricular activities, also known as complementary or non-compulsory ones, include student participation in activities such as tutoring, scientific research, extension projects, junior enterprise, student representation, congresses and scientific events (Bardagi and Hutz, 2012; Fior and Mercury, 2009).

In general, the works in the literature associate extracurricular activities with the development of soft skills. Studies point out that participation in extracurricular activities can result in more satisfaction and commitment during an undergraduate course, thereby improving leadership and interpersonal skills (Fior and Mercuri, 2009). Some of these experiences are seen by most students as an opportunity to professionally prepare for the future and also to develop creativity, social and communication skills and contact with other professionals (Bardagi and Hutz, 2012).

Studies show that extracurricular activities are important for university students' employability (Hu and Wolniak, 2010; Stevenson and Clegg, 2011). This fact is explained by the fact that participation in complementary activities demonstrates that students are concerned with their professional training and do not limit themselves to the classroom environment, thereby making employers believe that they will be more rounded and able to exercise their activities (Hu and Wolniak, 2010).

In view of this, the following hypotheses were formulated:

H2: Undergraduate students and graduate believe that extracurricular activities stimulate both soft and hard skills.
H3: Undergraduate students and graduate believe that soft skills are best developed in extracurricular activities.
H4: Professionals (graduate who working) believe they perform soft skills better in their daily activities.
H5: Professionals (graduate who working) who participated in extracurricular activities during their undergraduate course believe they are performing better in all skills.
H6: Undergraduate students and graduate believe curricular activities stimulate hard skills more.

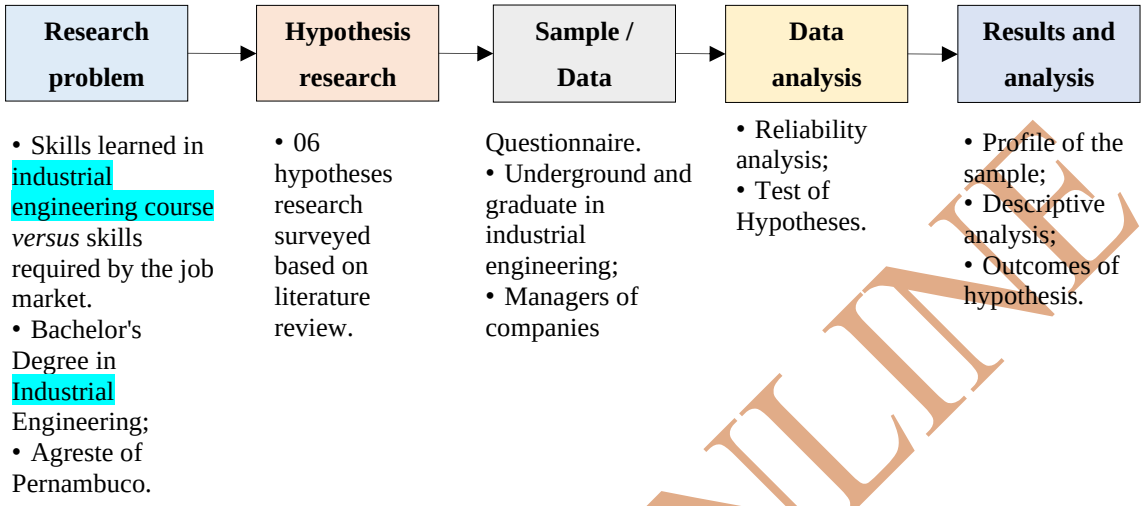
3 Methodological procedures

This study can be classified as taking an exploratory and descriptive and mixed approach (quali-quantitative). The procedure used was like field research, seeking to observe,

collect, analyse and interpret the scenario of the object of study. The steps undertaken are shown in the flowchart of Figure 1.

Figure 1

Research design



Source: adapted from Aragão and Fontana (2023).

3.1 Research problem and context

"In the 21st century, with the exponential increase in the global population and a greater demand for environmental resources, the focus of engineering is on integrated solutions within a multifaceted context" (Minur, 2021), where, in addition to their technical skills, engineers need interpersonal skills that help them face the challenges of working in multidisciplinary teams and making complex decisions.

In Brazil, Resolution No. 2, of April 24, 2019, which establishes the national curriculum guidelines for the undergraduate course in engineering, deals with the expected profile of graduates from engineering courses. In this text, the importance of hard and soft skills for this professional is affirmed, where the engineer, among other characteristics, must: "have a holistic and humanistic vision, be critical, reflective, creative, cooperative and ethical and with strong technical training" (Ministry of Education - MEC, 2019). This led to the need to review the curriculum plans of engineering courses in Brazil.

In addition, Resolution No. 07 of December 18, 2018, of the National Council of Education (CNE), established the Guidelines for Extension Activities in Brazilian Higher Education and defined placing Extension activities in the curriculum as the process of including extension activities in the curriculum of the Courses, considering the inseparability of teaching and research (the teaching-research-extension triad). However, these triads still have a fragile connection with each other (Gonzatti et al., 2018), and many universities face cultural barriers to the extension curriculum.

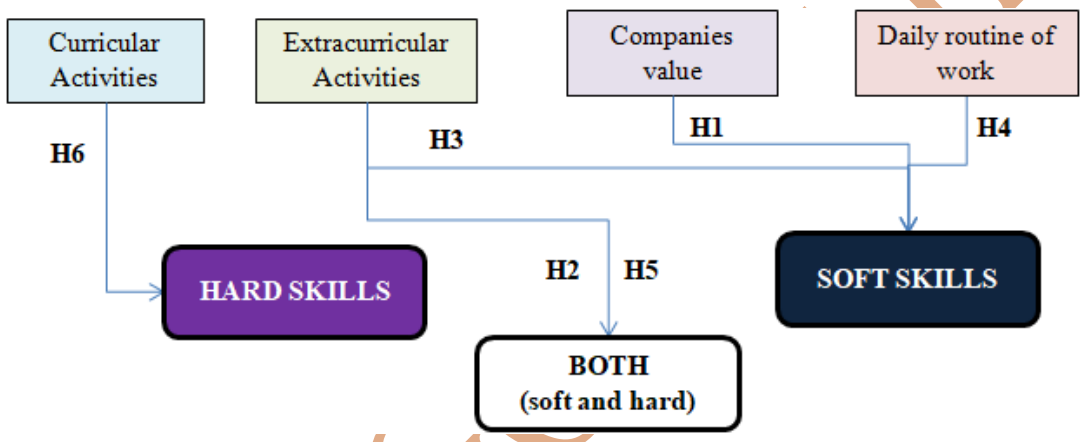
The research locus chosen, for convenience, was the Bachelor's Degree in Industrial Engineering at the Agreste Academic Center of the Federal University of Pernambuco (UFPE). Until the time of this research, the course had not yet included extension activities in the curriculum. Therefore, in this study only classroom subjects will be considered curricular activities.

3.2 Hypothesis research

Based on the literature review, Figure 2 shows the theoretical model and its constructs.

Figure 2

Theoretical model



Source: The authors (2023).

3.3 Sample and data collection

The data collection instruments were structured self-administration questionnaires, using an electronic form. Two questionnaires were formulated based on the target audience of respondents: A - Undergraduate students and graduate, and B – Company managers. The questionnaire underwent a pre-test phase to verify its consistency and was applied to the sample defined. The sections of the two questionnaires and their purposes are shown in Table 2. The questionnaire is available upon request.

Table 2

Summary of the questionnaires

Questionnaire A – Undergraduate students and graduate			
Section	**Goal**	**Number of items**	**Hypothesis**
Section 1 – Personal data	Profile of the respondents	06	
Section 2 – About the skills	General analysis of skills (hard and soft) stimulated during the undergraduate course as a whole	03	
Section 3 – Curricular Activities	Analysis of each specific skill stimulated during curricular activities	02	H6
Section 4 – Extracurricular Activities	Analysis of each specific skill stimulated during extracurricular activities in both university and outside	04	H2, H3 and H5
Section 5 – Work routine	Analysis of each specific skill performed in the daily work routine	02	H4 and H5
Questionnaire B – Company managers			
Section 1 – About the company	Profile of the companies	05	
Section 2 – Personal data of the interviewee	Profile of the respondents	05	
Section 3 – About the skills	General analysis of the importance of skills (hard and soft) for the company	04	
Section 4 – Importance	Analysis of the importance of each specific skill for the company	01	H1

Source: The authors (2023).

With the exception of the sections intended to study the profile of the respondent (or company), a 5-point Likert scale was considered (1 - "not at all developed/completely disagree" to 5 - "very developed/completely agree"). In sections 3-5 (questionnaire A) and section 4 (questionnaire B), the list of skills was presented (Table 1), and respondents evaluated each skill using the 5-point Likert scale mentioned, allowing an individualized analysis by skills. To not to influence respondents in this assessment, the category of these skills ("soft" or "hard") was omitted.

The collect data were treated similarly to Rocha and Delamaro (2012), i.e., the median was analysed. So, as the Likert scale used shows two levels of rejection (1 and 2), there being a neutral level (3) and two levels of agreement (4 and 5), it was concluded that medians below 3 mean a disagreement with the statements proposed in the questionnaires of the survey.

Considering the reported context, for questionnaire A, this study considered as population size the number of undergraduate students in Industrial Engineering regularly enrolled and those recently graduated from the same course. Thus, the proportion and stratified sample (95% confidence level and a sampling error of 0.07) are shown in Table 3.

Table 3

Numbers of the sample

	Students	*former students*	*Totals (∑)*
Size of the population	331	141	472
Proportion	0.701	0.299	1
Sample size	**97**	**42**	**139**

Source: The authors (2023).

As for questionnaire B, sampling was defined by convenience considering two criteria: (1) location - the company should have at least one unit in the rural region of Pernambuco, Brazil, as it is the same location as the students' course (questionnaire A); and (2) hiring - the company needed to have at least one employee trained in Industrial Engineering. The questionnaires were sent online in October 2021 via the Microsoft Forms platform.

3.4 Analysis of the data

Cronbach's alpha coefficient (α) was used as an estimator of the questionnaire's internal consistency. This method is crucial when you want to ensure that the responses are not random, but rather reflect a coherent and homogeneous structure within the instrument (Aragão and Fontana, 2023; Izah et al., 2023; Viladrich et al, 2017). To calculate the coefficient, the SPSS Statistics software, version 28.0.1.0, was used. This analysis was performed for all questions that used the 5-point Likert scale, as shown in Table 4. As all Cronbach's alpha coefficient values calculated for the two questionnaires in all sections are above 0.8 the internal consistency of the questionnaire is considered acceptable (recommended value between 0.7 and 0.9) (Aragão and Fontana, 2023).

Table 4 – Value of Cronbach's alpha coefficient of the questionnaires

Section of the questionnaire	Cronbach's alpha coefficient
Questionnaire A – Students	
Section 3 – Curricular activities	0.853
Section 4 – Extracurricular activities (university)	0.884
Section 4 – Extracurricular activities (outside)	0.897
Section 5 – Skills performed in the daily work routine	0.918
Questionnaire B – Company managers	
Section 4 – Importance of the skills for the companies	0.841

Source: The authors (2023).

Having defined a confidence level of 95% and a significance level (α) of 0.05, with the help of SPSS Statistics software, version 28.0.1.0 of 2021 and of Microsoft Excel software, the hypotheses were analysed in the "Wilcoxon Signed Rank Test". This non-parametric test is intended for testing the median of a sample and is suitable for this study. Furthermore, the test does not make assumptions about the normality of the data, being useful for any sample size (Rocha and Delamaro, 2012). The null hypothesis of this test states that there is no difference between the medians of the selected data, in other words, we have:

H_0: The median of the differences between sample A and B is equal to zero.
H_1: The median of differences between sample A and B is different from zero.

When the value of $p \leq \alpha$, the difference between the medians is significantly different and it is decided to reject H_0; and when the value of $p > \alpha$, this means that the difference between the medians is not significantly different, i.e., H_0 should not be rejected.

4 Results and discussion

Questionnaire A obtained 165 validated responses, where 69.09% (114 responses) are from undergraduate students and 30.91% (51 responses) are from recent graduates, i.e., guaranteeing the sample proportion. While questionnaire B obtained 24 validated responses from company managers.

4.1 Profile of the sample and descriptive analysis

In questionnaire A, 73% of respondents claimed to understand the concept of hard and soft skills, but only 23% of them know the skills of the future cited by WEF (2020). Overall, most students agree (57%), partially or fully, that hard skills are developed much better in

classroom experience than soft skills are. Table 5 shows the evaluation of skills by respondents (undergraduate and graduated).

Table 5

Evaluation of skills by undergraduate and graduated – questionnaire A

Skill	Section 3 – Curricular activities					Section 4 – Extracurricular activities (university)				
	1	2	3	4	5	1	2	3	4	5
S1	4.8%	21.8%	15.8%	49.1%	8.5%	0.0%	0.0%	4.3%	55.7%	40.0%
S2	4.2%	27.9%	15.2%	41.2%	11.5%	1.7%	3.5%	5.2%	53.9%	35.7%
S3	1.8%	18.2%	17.6%	44.2%	18.2%	0.0%	0.9%	8.7%	51.3%	39.1%
S4	3.0%	9.7%	16.4%	58.8%	12.1%	0.0%	0.9%	3.5%	56.5%	39.1%
S5	7.9%	31.5%	30.3%	27.3%	3.0%	0.0%	4.3%	7.8%	46.1%	41.7%
S6	13.3%	39.4%	20.6%	23.6%	3.0%	2.6%	9.6%	8.7%	36.5%	42.6%
S7	7.3%	31.5%	25.5%	31.5%	4.2%	2.6%	10.4%	20.0%	51.3%	15.7%
S8	4.2%	30.3%	27.3%	33.9%	4.2%	3.5%	11.3%	24.3%	43.5%	17.4%
S9	15.2%	24.2%	17.0%	29.1%	14.5%	4.3%	8.7%	11.3%	42.6%	33.0%
S10	1.2%	8.5%	10.9%	59.4%	20.0%	0.0%	0.9%	8.7%	47.0%	43.5%
S11	29.7%	42.4%	17.6%	7.9%	2.4%	9.6%	20.0%	11.3%	38.3%	20.9%
S12	12.1%	37.0%	20.0%	27.3%	3.6%	1.7%	13.9%	17.4%	32.2%	34.8%
S13	5.5%	33.3%	30.9%	25.5%	4.8%	2.6%	7.0%	22.6%	41.7%	26.1%
S14	4.2%	16.4%	20.0%	54.5%	4.8%	3.5%	5.2%	26.1%	48.7%	16.5%
S15	19.4%	38.8%	19.4%	16.4%	6.1%	6.1%	12.2%	9.6%	36.5%	35.7%
S16	31.5%	42.4%	17.6%	7.3%	1.2%	14.8%	35.7%	22.6%	19.1%	7.8%
S17	30.9%	30.3%	18.2%	18.8%	1.8%	24.3%	24.3%	21.7%	23.5%	6.1%
Skill	**Section 4 – Extracurricular activities (outside)**					**Section 5 – Skills performed in the daily work routine**				
	1	2	3	4	5	1	2	3	4	5
S1	1.4%	5.4%	16.2%	50.0%	27.0%	3.5%	2.3%	2.3%	52.3%	39.5%
S2	0.0%	4.1%	13.5%	54.1%	28.4%	2.3%	2.3%	3.5%	50.0%	41.9%
S3	1.4%	5.4%	18.9%	51.4%	23.0%	2.3%	2.3%	14.0%	33.7%	47.7%
S4	0.0%	5.4%	12.2%	55.4%	27.0%	1.2%	2.3%	3.5%	46.5%	46.5%
S5	1.4%	10.8%	13.5%	45.9%	28.4%	1.2%	8.1%	10.5%	37.2%	43.0%
S6	5.4%	21.6%	18.9%	39.2%	14.9%	1.2%	10.5%	12.8%	33.7%	41.9%
S7	2.7%	10.8%	12.2%	40.5%	33.8%	1.2%	9.3%	15.1%	47.7%	26.7%
S8	4.1%	9.5%	17.6%	39.2%	29.7%	3.5%	17.4%	17.4%	36.0%	25.6%
S9	5.4%	18.9%	18.9%	37.8%	18.9%	0.0%	5.8%	8.1%	32.6%	53.5%
S10	0.0%	6.8%	16.2%	52.7%	24.3%	0.0%	1.2%	0.0%	45.3%	53.5%
S11	8.1%	18.9%	20.3%	33.8%	18.9%	2.3%	8.1%	18.6%	34.9%	36.0%
S12	4.1%	12.2%	12.2%	51.4%	20.3%	1.2%	4.7%	5.8%	40.7%	47.7%
S13	5.4%	18.9%	24.3%	37.8%	13.5%	0.0%	4.7%	11.6%	41.9%	41.9%
S14	2.7%	13.5%	16.2%	37.8%	29.7%	1.2%	9.3%	14.0%	41.9%	33.7%
S15	8.1%	25.7%	12.2%	36.5%	17.6%	2.3%	16.3%	10.5%	31.4%	39.5%
S16	6.8%	5.4%	13.5%	32.4%	41.9%	14.0%	29.1%	17.4%	22.1%	17.4%
S17	25.7%	17.6%	29.7%	17.6%	9.5%	19.8%	15.1%	19.8%	27.9%	17.4%

Source: The authors (2023).

Analysing the skills, it was observed that the five that were considered most developed in undergraduate curricular activities were, respectively, S10, S4, S3, S14 and S1, where only S1 is categorized as a soft skill. The five least developed skills were: S16, S11, S17, S15 and S6, where three of them are soft skills and two of them are hard skills.

Regarding extracurricular activities, 70% of respondents reported their participation in: Research groups (39.1%), Junior enterprise (24.8%), Extension groups (20.63%), Academic Directorate (8.9 %) and miscellaneous (6.3%). For them, the skills most developed by these activities are: S1, S4, S3, S10 and S2, where three are hard skills and two soft skills. Among those least developed, the following stand out: S16, S17, S11, S15 and S12, where three are soft skills and two hard skills.

Still on extracurricular activities, there are those developed outside the scope of the university, such as courses, workshops and training, in which 64.3% of respondents already carry out some of these activities. As for the skills developed, the following stand out: S2, S4, S1, S10 and S3, where three are hard skills and two soft skills. In the ranking of undeveloped skills, there are: S17, S15, S6, S11 and S9. Among them, only one hard skill and four soft skills appear.

Finally, those who are already in the job market (52.1%), i.e., the professional, were asked if they believe they are adequately performing all the skills presented. Analysing the data, it was observed that the skills that the participants most agree they are performing in their daily work routine are, in order: S10, S4, S1, S2 and S12, where two are hard skills and three soft skills. Regarding the least performed, the following stand out: S16, S17, S8, S15 and S6, in which three are hard skills and two soft skills.

Table 6 summarizes the sample profile for questionnaire B. Most respondents (75%) claimed to know the concepts of hard and soft skills. It was also asked which of these two groups of skills was most observed by companies when hiring a new employee, to which 83.3% answered that these are behavioural skills (soft skills).

Next, the importance given by the companies to the skills listed by this survey was evaluated. Table 7 presents this result. In general, most skills were assessed as important for companies, but some ended up standing out. Among those with the highest degree of importance, they appear in descending order: S5, S9, S10, S1 and S2. When analysing the nature of these skills, four of them are considered to be soft skills and one is a hard skill. On the other hand, those with the lowest degree of importance were analysed, which resulted in: S16, S17, S14, S8 and S7. Of these skills, all are considered hard skills.

Table 6

Profile of the sample – questionnaire B

Respondent			Company		
Variable	**Response**	**%**	**Variable**	**Response**	**%**
Work sector	Human Resources (HR)	45.8%	***Type***	Commercial	33%
	Administrative/financial	33.3%		Industrial	67%
	Commercial	8.3%	***Sector***	Food	25%
	Operational or production	8.3%		Beverages	17%
	Project Management	4.2%		Metallurgy	17%
Position	Human Resources Analyst	33.3%		Automotive	8%
	Operations Manager	16.7%		Retail	8%
	Engineering Analyst	12.5%		Construction	4%
	Human Resources Manager	12.5%		Logistics	4%
	Junior Project Analyst	8.3%		Home Centre	4%
	Training and Development Coordinator	4.2%		Ceramics	4%
	Administrative Director	4.2%		Machinery Rental	4%
	Transport Supervisor	4.2%	***Size***	Large	88%
				Medium	8%
				Small	4%

Source: The authors (2023).

Table 7

Evaluation of skills by company managers

Skill	*Section 4 – Importance of the skills for the companies*				
	1	**2**	**3**	**4**	**5**
S1	0.0%	4.2%	8.3%	29.2%	58.3%
S2	0.0%	4.2%	8.3%	45.8%	41.7%
S3	0.0%	4.2%	8.3%	54.2%	33.3%
S4	0.0%	0.0%	16.7%	29.2%	54.2%
S5	0.0%	0.0%	4.2%	50.0%	45.8%
S6	0.0%	4.2%	16.7%	50.0%	29.2%
S7	0.0%	12.5%	16.7%	41.7%	29.2%
S8	8.3%	12.5%	33.3%	25.0%	20.8%
S9	0.0%	0.0%	8.3%	25.0%	66.7%
S10	0.0%	0.0%	8.3%	37.5%	54.2%
S11	0.0%	0.0%	12.5%	29.2%	58.3%
S12	0.0%	0.0%	20.8%	41.7%	37.5%
S13	0.0%	0.0%	16.7%	45.8%	37.5%
S14	8.3%	16.7%	37.5%	20.8%	16.7%
S15	0.0%	8.3%	16.7%	33.3%	41.7%
S16	16.7%	41.7%	12.5%	20.8%	8.3%
S17	25.0%	16.7%	37.5%	12.5%	8.3%

Source: The authors (2023).

4.2 Outcomes of hypotheses

Table 8 summarizes the results of the Wilcoxon hypothesis tests, for a confidence level of 95% and a significance level (α) of 0.05. There is evidence that supports the decision to reject the null hypothesis, thus confirming all the hypotheses surveyed in this research.

Table 8

General result of the hypotheses

Hypothesis	p-value	Decision
H1 Soft skills are more important than hard skills in the everyday operations in a company	0.00	Reject H_0
H2 Undergraduate students and graduate believe that extracurricular activities stimulate both soft and hard skills	0.00	Reject H_0
H3 Undergraduate students and graduate believe that soft skills are best developed in extracurricular activities	0.00	Reject H_0
H4 Professionals (graduate who working) believe they perform soft skills better in their daily activities	0.027	Reject H_0
H5 Professionals (graduate who working) who participated in extracurricular activities during their undergraduate course believe they are performing better in all skills	0.032	Reject H_0
H6 Undergraduate students and graduate believe curricular activities stimulate hard skills more	0.00	Reject H_0

Source: The authors (2023).

Finding a job after years of study is the main objective of most engineering graduates. However, opportunities are limited (Munir, 2022) and the skills valued by companies at the time of hiring converge to soft skills. This situation confirms what was observed in studies such as the one by IBM (2018), pointing to a greater demand in the market for behavioural skills than for techniques. Kumar et al. (2021) concluded in their studies that training in soft skills has a positive effect on employability, since emotional intelligence appears as essential in the opinion of employers when recruiting recent graduates. In addition, employers are dissatisfied with professionals who do not meet the expectations of the economic environment, this being one of the main causes of unemployment (Daud et al., 2011; Dogara et al., 2019).

One of the findings of this research is the positive relationship between the development of skills in general and the participation of students in extracurricular activities. Furthermore, there is a positive relationship between extracurricular activities and the development of soft skills. In summary, students believe they are developing more skills within extracurricular activities, especially soft skills. This corroborates findings in studies by Alwi et al. (2020), Chong and Thi (2020) and Escudeiro and Escudeiro (2012).

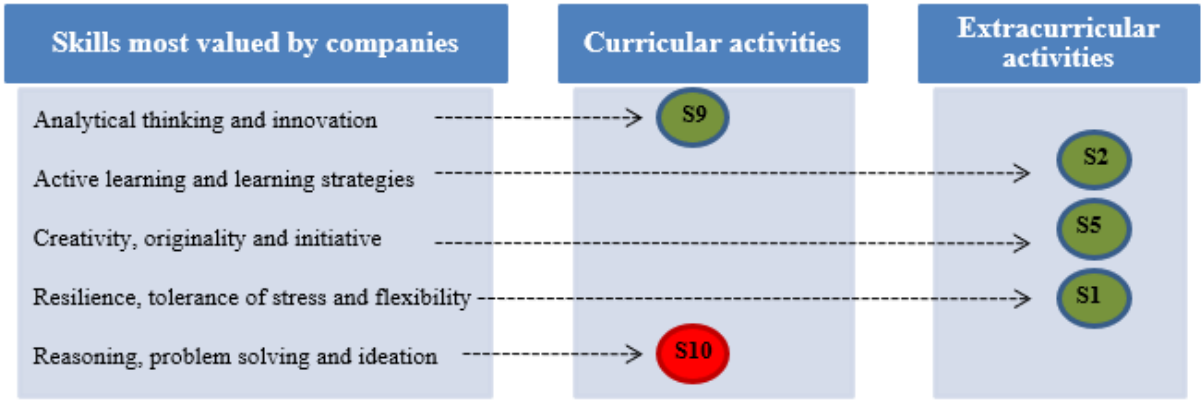
Personal skills can be developed during undergraduate courses by means of the teaching and learning process. However, in the opinion of students and former students (recent graduates), curricular activities stimulate hard skills to a greater extent. Studies such as those by Dogara et al. (2019) conclude that it is important for departments to review the curriculum of their courses in order to include more practical activities. Furthermore, it is

recommended that teachers encourage inclusion in these activities to make students more employable. In the case of engineering in Brazil, complying with resolutions nº 7 (CNE, 2018) and nº 2 (MEC, 2019). Succi and Wieandt (2019) argued that universities, companies and professionals should work together to develop the skills that professionals must have to enter and remain in the job market.

Figure 3 shows the five skills most valued by companies and in which type of activity (curricular or extracurricular) they are best developed from the point of view of students/recent graduates.

Figure 3

Skills developed versus the value given to these by companies



Source: The authors (2023).

Among the five skills highlighted in Figure 3, four are soft skills, reaffirming the importance of this group of skills. In addition, extracurricular activities are seen to be more efficient in this group of skills. This result is in line with research by dos Santos and Simon (2018) and Munir (2022), showing that there are gaps to be solved between the skills valued by companies and those being developed by universities.

5 Conclusion

Considering market trends and its needs for professionals with soft skills, such as emotional intelligence, creativity, innovation, and leadership (WEF, 2020), and the resolutions nº 7 (CNE, 2018) and nº 2 (MEC, 2019), we can observe the importance of Higher Education courses developing soft skills in addition to traditional technical skills, and moreover why it is important to fit extra-curricular activities, and other types of activity into the curriculum, such as those cited in this article. Furthermore, according to the Brazilian Indicators for Sustainable Development Goals (SDG) (https://odsbrasil.gov.br/), SDG4 deals with quality education, i.e.,

ensuring inclusive and equitable quality education, and promoting lifelong learning opportunities for all. It further specifies the need by 2030 for:

a) Ensuring equal access for all men and women to quality technical, vocational and higher education at affordable prices, including at university;
b) Substantially increasing the number of young people and adults who have relevant skills, including technical and professional skills, for employment, decent work and entrepreneurship;
c) Ensuring that all learners acquire the knowledge and skills necessary to promote sustainable development, including, inter alia, by offering education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and valuing cultural diversity and the contribution of culture to sustainable development.

This research meets this objective, since it increases the understanding of the skills developed, stimulating educators and Higher Education Institutions to rethink the teaching and learning processes. It reinforces the statement made by Gouda (2022) that concluded a significant positive relationship between learning abilities and future skills development.

For companies, the study of skills is important so that they may understand which ones have the greatest impact on the activities of each function within the organization, and thus will incorporate this thinking when recruiting and selecting professionals to join the company. Sá and Serpa (2018) stated that the development of transversal skills is necessary for sustainable development in companies. In addition, these organizations must always be seeking to improve their employees' skills by mounting development programs and those that offer training on upskilling/reskilling.

It should be pointed out that this research does not aim to prioritize soft skills to the detriment of hard skills, but to emphasize the importance of combining these two groups of skills for better professional performance. Thus, as highlighted by Franco-Ángel (2022) while the importance of the two categories of skills is confirmed, he concluded that soft skills better explain the performance of students in the job market. Today's engineers face challenges when they enter the workforce very different from those of past generations. This is because the rapid pace of technological change is overwhelming the ability of education and workforce systems to train individuals with an appropriate set of skills (Chrisinger, 2019; Munir, 2022).

This work has as a limitation the scope of the research, as only one type of engineering (Industrial) and one location (Pernambuco) was analysed. In order to generalize the results, it would be important to increase the scope of the research. This is left for future research to tackle. However, the field study carried out portrays well what is taught at public universities

in Brazil, a developing country, which is useful for researchers in other locations. Andreas (2018) revealed that even in the United States (a country considered developed) there is an inability of colleges to prepare students for the job market, especially in relation to soft skills.

References

Abelha M., Fernandes S., Mesquita D., Seabra F., & Ferreira-Oliveira A. T. (2020). Graduate employability and competence development in higher education—A systematic literature review using PRISMA. *Sustainability,* 12(15), 1-27. https://doi.org/10.3390/su12155900

Alves R et al. (2016). University extension and education on sexually transmitted diseases and related topics. *Journal of the University of Vale do Rio Verde*, 14(2), 1079-1083.

Alwi, N.M., Isa, K.M., Abidin, N.H.Z., Yussof, S.H., & Bakar, I.S.A. (2020). Graduate employability among low academic achievers. *New Educational Review,* 62, 46-56.

Andreas, S. (2018). Effects of the decline in social capital on college graduates' soft skills. *Industry and Higher Education,* 32 (1), 47-56. https://doi.org/10.1177/0950422217749277

Aragão, J.P.S., & Fontana, M.E. (2023). Guidelines for public sector managers on assessing the impact of outsourcing on business continuity strategies: a Brazilian case. *Journal of Global Operations and Strategic Sourcing,* 16(1), 118-141. https://doi.org/10.1108/JGOSS-07-2021-0051

Bardagi, M.P., & Hutz, C.S. (2012). Academic routine and relationship with colleagues and professors: Impact on university dropout. *Psycho Magazine,* 43(2).

Baird, A.M., & Parayitam, S. (2019). Employers' ratings of importance of skills and competencies college graduates need to get hired: evidence from the New England region of USA. *Education+ Training,* 61(5), 622-634.

Bredenkamp, D., Botma, Y., & Nyoni, C.N. (2023). Higher education students' motivation to transfer learning: a scoping review. Higher Education, Skills and Work-Based Learning, 13(1), 36-52. https://doi.org/10.1108/HESWBL-03-2022-0057

Chong, Y., & Thi, L. S. (2020). University freshman mentoring effectiveness and scale

enhancement. *Asian Journal of University Education,* 16(1), 181-189.

Chrisinger, D. (2019). The solution lies in education: artificial intelligence & the skills gap. *On the Horizon,* 27(1), 1-4. https://doi.org/10.1108/OTH-03-2019-096.

Chryssolouris, G., Mavrikios, D., & Mourtzis, D. (2013). Manufacturing systems: skills & competencies for the future. *Procedia CIRP,* 7, 17-24. https://doi.org/10.1016/j.procir.2013.05.004.

Daud S, Sapuan NM, Abidin N and Rajadurai J (2011) Do business graduates' attributes fulfill industry requirements and expectations? *Australian Journal of Basic and Applied Sciences,* 5(9), 68-74.

Dogara, G., Saud, M.S.B., Kamin, Y.B., Francis, B.S. (2019). The impact of generic skills on building technology graduates' employability. *International Journal of Recent Technology and Engineering,* 8(3), 2967-2972.

Dos Santos, P.F., & Simon, A.T. (2018). An evaluation of the competences and abilities of the production engineer in the industrial environment. *Gestão & Produção,* 25, 233-250. https://doi.org/10.1590/0104-530X2081-18

Escudeiro, N.F., & Escudeiro, P.M. (2012). The multinational undergraduate teamwork project: an effective way to improve Students' soft skills. *Industry and Higher Education,* 26(4), 279-290. https://doi.org/10.5367/ihe.2012.0104.

Fior, C.A., & Mercuri, E. (2009). University education and curriculum flexibility: importance of mandatory and non-mandatory activities. Psicologia da Educação, 29, 191-215.

Franco-Ángel, M., Carabali, J., & Velasco, M.I. (2022). The internship performance of undergraduate students: are hard or soft skills more important?. *Industry and Higher Education,* 37(3), 384-396. https://doi.org/10.1177/09504222221127213

García-Aracil, A., Monteiro, S., Almeida, L.S. (2021). Students' perceptions of their preparedness for transition to work after graduation. *Active learning in higher education,* 22(1), 49-62.

Gonzatti, S.E.M., Da Silva, A.A., Chemin, A.P., Lazzari, U.M., De Maman, A.S., Bergmann, A.B., & Herber, J. (2018). Perspectives on university extension: perceptions of fellows

of the interdisciplinary networks project. *Revista Destaques Acadêmicos,* 10(4), 336-348. https://doi.org/10.22410/issn.2176-3070.v10i4a2018.2051

Gouda, H. (2022). Exploring the effects of learning abilities, technology and market changes on the need for future skills. Higher Education, Skills and Work-Based Learning, 12(5), 900-913. https://doi.org/10.1108/HESWBL-10-2021-0200

Helleno, A.L., Simon, A.T., Papa, M.C.O., Ceglio, W.E., Rossa, A.S., & Mourad, R.B.A. (2013). Integration university-industry: laboratory model for learning lean manufacturing concepts in the academic and industrial environments. *International Journal of Engineering Education,* 29(6), 1387-1399.

Hu, S., & Wolniak, G.C. (2010). Initial evidence on the influence of college student engagement on early career earnings. *Research in Higher Education,* 51(8), 750-766. https://doi.org/10.1007/s11162-010-9176-1

Institute for Business Value (2019). The enterprise guide to closing the skills gap: strategies for building and maintaining a skilled workforce". Avaliable at: https://www.ibm.com/downloads/cas/EPYMNBJA&gt (acessed 17 november 2021).

Ismail, A., Mohamad, M.H., Mohamed, H.A.B., Saludin, M.N., & Yusuf, M.H. (2011). An empirical study of the relationship between transformational leadership, empowerment and organizational commitment. *Business and Economics Research Journal,* 2(1), 89-107.

Izah, S. C., Sylva, L., & Hait, M. (2023). Cronbach's alpha: A cornerstone in ensuring reliability and validity in environmental health assessment. *Energy & Environment*, 23, 1057.

Kumar, S., Dinesh, N., & Periasamy, P. (2021). Testing validity and reliability of the questionnaire in soft skills research: A perspective from b-school alumni. *International Journal of Entrepreneurship*, 25(1), 1-10.

Matsouka, K., & Mihail, D.M. (2016). Graduates' employability: What do graduates and employers think?. *Industry and Higher Education,* 30(5), 321-326. https://doi.org/10.1177/095042221666371

Ministério da Educação – MEC (2019). Resolution No. 2, of April 24". Avaliable at: https://normativasconselhos.mec.gov.br/normativa/pdf/CNE_RES_CNECESN22019.pdf (acessed 15 may 2023).

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

Oliveira, F.L.B., & Almeida Júnior, J.J. (2015). Motivations of nursing students active in university extension projects: the experience of the Health Sciences Faculty of TRAIRÍ/UFRN. *Space for Health Magazine,* 16(1), 36-44.

Peres, A.M., Ciampone, M.H.T., & Wolff, L.D.G. (2007). Nurses' managerial skills from the perspectives of an undergraduate nursing course and the job market. *Work, Education and Health,* 5(3), 453–472. https://doi.org/10.1590/S1981-77462007000300007.

Rebele, J. E., & Pierre, E.K.S. (2019). A commentary on learning objectives for accounting education programs: The importance of soft skills and technical knowledge. *Journal of Accounting Education,* 48, 71-79.

Rocha, H.M., & Delamaro, M.C. (2012). Methodological approach in the analysis of data from non-parametric studies, based on answers in ordinal scales. *Revista Gestão da Produção Operações e Sistemas,* 3, 77-91. https://doi.org/10.15675/gepros.v0i3.649

Sá, M.J., & Serpa, S. (2018). Transversal competences: Their importance and learning processes by higher education students. *Education Sciences,* 8(3), 126.

Sharma, V. (2018). Soft Skills: An Employability Enabler. *Journal of Soft Skills,* 12(2), 25-32.

Stevenson, J., & Clegg, S. (2011). Possible selves: Students orientating themselves towards the future through extracurricular activity. *British Educational Research Journal,* 37(2), 231–246. https://doi.org/10.1080/01411920903540672

Succi, C., & Wieandt, M. (2019). Walk the talk: soft skills' assessment of graduates. *European Journal of Management and Business Economics,* 28(2), 114-125. https://doi.org/10.1108/EJMBE-01-2019-0011

Sun, Q., Kang, H., Archuleta, K., & Lambert, S. (2023). Guest editorial: Adult and higher education in changing global contexts: innovative theory and practices from Asian countries and beyond. Higher Education, Skills and Work-Based Learning, 13(3), 445-449. https://doi.org/10.1108/HESWBL-06-2023-289

Tang K.N. (2020). The importance of soft skills acquisition by teachers in higher education institutions. *Kasetsart Journal of Social Sciences,* 41(1), 22-27.

World Economic Forum – WEF (2020). The Future of Jobs Report 2020". Global Challenge Insight Report: October, 2020. Avaliable at: https://www.weforum.org/reports/the-future-of-jobs-report-2020 (acessed 20 november 2021).