



## External aspects that stand out in the self-perceived employability of engineering students and recent graduates

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### Abstract

The purpose of this study is to analyse the relationship between the self-perceived employability of engineering students and graduates and their employment situation. Methodology: A total of 505 individuals participated in this study, including recent graduates and senior students from five engineering programs at a public higher education institution in Colombia. This research adopted a quantitative methodology with a non-experimental cross-sectional design and a correlational scope. The data were analysed using inferential statistics. Findings: Based on the results, perceived employability considerably depends on four factors: the level of job performance, the number of promotions, work experience, and the education–job relationship. Originality: In the current labour context, employability is an important tool for graduates who are entering the labour market and must face a variety of challenges, such as the decline in work opportunities, the rapid development of technology, and the need for lifelong learning. According to the literature in the field, employability is significantly influenced by these kinds of external factors.

### Keywords

Salary, work experience, career development, self-perceived employability, engineering students, graduates, generic skills

### Introduction

Given the rapid introduction of new information technologies and the implementation of digital transformation in today's society as a result of globalization and Industry 4.0, adapting to the current changes is challenging (Patiño Torres, 2022). In particular, with the constant evolution of engineering, Higher Education Institutions (HEIs) are now required to have a comprehensive understanding of the tools necessary to train engineers. The aim is to help current professionals in the field meet the demands and expectations of the digital society, propose optimal solutions to the problems of the technological world they live in, and develop their potential by applying such solutions to local contexts (Shekhawat et al., 2019). This has, indeed, become a challenge for HEIs as well as for engineering students, who value not only the specialized skills of their field of study—which solely focus on labour market dynamics—but also broader competences—which consider humanistic, intellectual, and axiological aspects. These latter are believed to boost employability, defined as 'the ability to find, keep, and progress in graduate employment' (Behle, 2020). In addition, they transcend the boundaries of the engineering field while seeking the integral development of engineers, as stated

in the majority of engineering programs at HEIs. The transformation of engineering education has thus become a challenge and need in the field of higher education.

Resistance to curricular reform, however, is a major issue observed in most HEIs (Toruño, 2021). Traditional curricula mostly include core subjects that help students develop the specialized skills of their field of study but few courses to help them develop employability skills (Blondet, 2019; Sarkar et al., 2020). The relevance of professional skills and the premise that basic sciences and applied engineering are the fundamental pillars of engineering curricula have never been in question. However, uncertainties arise concerning the number of engineering science courses that are truly necessary, the methodology employed for teaching and learning, and their effective integration with professional skills, especially the non-technical ones (Winberg et al., 2020). As a result of this, there is a pressing need to reform engineering curricula. Yet, this has raised doubts as to the type of changes that must be made and how to implement them. In light of these challenges that HEIs are now dealing with, Neri and Hernández (2019) suggest using interactive and collaborative curricula to properly contextualize the teaching of the courses and thus meet students' training objectives. It is, therefore, imperative to design teaching strategies that enhance training and incorporate skills like creativity, persuasion, collaboration, adaptability, and emotional intelligence, which are highly sought after by companies. Universities cannot afford to overlook these realities; instead, they should proactively anticipate future trends (European Economic Community, 2022).

In the field of engineering, the labour market requires graduates to possess a variety of skills beyond the technical aspect and in-depth knowledge of their field of study. As indicated by various reports, the 21st-century engineer must have both generic and specific skills, which combine cognitive, socio-affective, axiological, attitudinal, and aptitude components (Martín-González et al., 2019). Likewise, several authors have suggested that engineers need certain competencies to be employed and advance in their careers. According to various studies such as those of Pugh and Lozano-Rodríguez (2019) and de Campos et al. (2020), employers highly value graduates who can communicate effectively, collaborate with others, act proactively, think critically, and solve problems. These abilities, nonetheless, have been overlooked or not even considered in curricula.

Although some authors (Benbow et al., 2021; Martín Erro et al., 2022) have investigated the core skills necessary for professionals (engineers in particular), this study expands the scope by suggesting a number of factors—besides the required technical skills—that influence employability. A holistic framework composed of four categories (individual factors, individual circumstances, enabling support system, and labour market) is here used to classify and measure employability (Behle, 2020). Particularly, we focus on three key aspects of employability development and analyse employability from an individuals' perspective, i.e., what people look for in a job (such as their odds of success and job satisfaction) and the factors that affect their perceptions. This is what distinguishes this study from much of the existing publications on employability, which have concentrated on the effects of government policies, companies' human resource strategies, society in general, and educators. Moreover, this study contributes to bridging the gap between theory and reality in terms of the relational knowledge between the 'internal' factors of employability (e.g., individuals' set of skills and their application to their studies) and the 'external' factors of employability (e.g., individuals' perception of the general state of the labour market, the strength of the university brand, and their awareness of specific subject areas). Finally, we expect to find a strong correlation between employability and four specific components of individuals' employment situation: (i) level of job performance, (ii) number of promotions, (iii) work experience, and (iv) education–job relationship.

## Theoretical framework

### Generic skills in engineering

With few exceptions, engineering students and professionals today continue to receive traditional education and training, which is essentially based on curricula designed to manufacture machines and artifacts. Even though this educational paradigm has allowed the field of engineering to produce

innovative machines and technologies for society, most engineering programs forgo intellectual curiosity and breadth to concentrate only on technological studies and precision. While engineering still requires precise technological skills, the 21st-century innovation economy demands a new professional perspective that acknowledges the value of complex systems thinking, interdisciplinary collaborations, economic and environmental impacts (sustainability), effective communication, and global and community leadership to consider all society's needs. Engineering education must, therefore, go beyond technology, be sufficiently robust and flexible, and focus on designing systems to meet the challenges of the 21st century, considering their increasing complexity and transdisciplinary nature (Grasso and Burkins, 2010). To attain this, there must be a balance between the generic and specific skills relevant to the job profile and needs of the industry.

### **The concept of employability in higher education**

The concept of *employability* first appeared in the UK in the Dearing Report (published in 1997) to explain that to guarantee better job performance, study plans must include other skills in addition to cognitive knowledge (Orellana, 2018). By the 1990s, the concept of *employability* had become multidimensional. For instance, Gazier (2001) introduced the individual and collective dimensions of employability, which include profiles, work experience, and the contextual factors of the labour market. Likewise, Hillage and Pollard (1998) assumed that the concept is multimodal, with diverse uses depending on the time, place, and actors involved (society, government, employer, unions, associations, academia, and employees). According to Harvey (2001), the concept of employability has been investigated from a variety of perspectives and fields (including psychology, education, politics, and economics), as well as from the standpoint of different stakeholders (including the government, businesses, universities, and scholars).

Since employability is influenced by an individual's experiences, context, and labour market, it is open to subjective interpretation. In this regard, Hillage and Pollard (1998) presented an employability framework that emphasizes the various elements that interact within the concept of employability: assets, presentation, deployment, and external factors. Assets include personal attributes and basic traits (e.g., reliability and honesty); specific, generic, and key skills (e.g., communication and problem solving); and high-level skills (e.g., teamwork and business awareness). Presentation is defined as individuals' ability to arrange an appointment for an appropriate position by demonstrating their employability assets. Deployment refers to a variety of skills, including career management skills (e.g., awareness of one's own strengths and limitations and opportunities in the labour market, as well as decision-making and transition skills) and job search skills. Finally, external factors are the elements associated with the context, such as local labour market demand.

Similarly, Evans et al. (1999, as cited in McQuaid and Lindsay, 2005) proposed dividing the concept of employability into (i) employability components or supply-side elements and (ii) external factors or demand-side elements. Employability components include 'the extent of the individual's transferable skills, the level of personal motivation to seek work, the extent of the individual's 'mobility' in seeking work, access to information and support networks, and the extent and nature of other personal barriers to work' (p. 207). External factors, for their part, include 'the attitudes of employers towards the unemployed, the supply and quality of training and education, the availability of other assistance for disadvantaged job seekers, and (most importantly) the supply of appropriate jobs in the local economy' (p. 207). Considering this, McQuaid and Lindsay (2005) developed their own reordered 'holistic' framework of employability determinants, which comprises three interconnected elements, or sets of factors, that have an impact on an individual's employability: individual factors, personal circumstances, and external factors.

Despite the increasing prominence of the concept of employability, there is no consensus on its definition and how it can be measured. According to Vanhercke et al. (2014), employability is divided into: (i) competence-based employability, which refers to individuals' perception of their skills and abilities that promote employment opportunities; (ii) dispositional employability, which focuses on individuals' perception of their proactive attitudes regarding their career and work in general; (iii) and

perceived employability, which is defined as individuals' perception of their possibilities of obtaining and maintaining a job. This proposal, however, is tied to a broader distinction between input-based employability (i.e., strengths and resources that foster career success) and outcome-based employability (i.e., the extent to which it will be easy to find a similar or better job).

### Dispositional employability

According to Fugate and Kinicki (2008) and Fugate et al. (2004), dispositional employability is 'a constellation of individual differences that predispose employees to (pro)actively adapt to their work and career environments' (p. 20). In other words, it captures the individual characteristics that foster adaptive behaviours and positive work outcomes, making it easier for employees to seek and take advantage of career opportunities within and outside an organization. The disposition of employability encompasses proactive individual characteristics, such as adaptation and willingness to change, which help individuals to prepare ahead of time for these changes rather than waiting for them to occur abruptly. There are, however, prerequisites for workplace adaptation, including those individual differences that promote active adaptability (e.g., optimism), adaptive schemes or a cognitive component, and the ability to learn and change to meet demands (Ashford and Taylor, 1990).

Fugate et al. (2004) describe dispositional employability as having a multifunctional structure that is framed in active adaptability at work and manifested in the following five dimensions:

**Openness to changes at work:** Individuals regard change as a challenge instead of a threat. They are capable of developing individual attitudes such as continuous learning, which allows them to improve their personal adaptability, making them more employable.

**Work and career resilience:** Optimism is one of the most important characteristics in resilient people. Optimistic individuals see career success as the personal effort made to accomplish the desired goals. In addition, they maintain a positive outlook on future changes and show confidence in dealing with challenges.

**Work and career proactivity:** People proactively gather information related to career interests (either independently or with the employer), which can help them decide where to focus efforts and reduce uncertainty and anxiety.

**Career motivation:** It is based on motivation control and learning goal orientation, as employees who set goals are more motivated at work and better able to deal with boredom and challenges. Motivated individuals seek learning and training opportunities and are willing to adapt to meet demands.

**Work identity:** It refers to how individuals define themselves in the context of their career. People who consider themselves employable have a strong cognitive and affective foundation.

In short, it is fair to say that employability is a key aspect in social life because it pertains to both individuals who are looking for a job and those who are employed. Although it has been given different definitions, most of them reflect the same idea: individuals' probability of obtaining a job, maintaining it, and being promoted. As previously mentioned, this construct comprises a variety of individual, external, and professional factors. Thus, the aim of this study is to propose a multidimensional notion of self-perceived employability and analyse how it interacts with four external factors (or independent variables): level of job performance, number of promotions, education–job relationship, and employment status. For such purpose, we designed an instrument that measures both the self-perceived employability of university students and recent graduates, as well as the level of importance of social–emotional competences for employability. Based on the conceptualization outlined in this section, the designed instrument considers the following three factors: (i) internal factors, which are the personal attributes that make individuals more employable, (ii) external factors, which influence individuals' ability to secure a job, and (iii) career development, which leads to work transitions by realizing individuals' career potential.

## Methodology

### Variables

The independent variables we considered were (i) education–job relationship, which was measured on a scale ranging from 1 to 5, where 1 indicates ‘no relationship’ and 5 indicates ‘a very strong relationship’; (ii) level of job performance, which included being underqualified (‘My level of knowledge and skills was below that required for my job’), being adequately qualified (‘My level of knowledge and skills was reasonably adequate to that required for my job’), or being overqualified (‘My level of knowledge and skills was above that required for my job’); (iii) number of promotions (none, 1, 2, 3, or more); and (iv) Employment status (1 = no work experience, 2 = employed, 3 = unemployed). The main dependent variables were grouped into three factors: (i) internal factors, which included employability skills, social and emotional competences, and perception of the internal and external labour market; (ii) external factors, which included the impact of the university, organizational support, and support from the university; and (iii) career development, which included career commitment, awareness of the program, job satisfaction, and career success). A five-point Likert scale was employed to measure these variables.

### Population and sample

The study participants comprised senior students enrolled, from January to June 2022, in the five engineering programs offered by the Instituto Tecnológico Metropolitano (ITM) in Colombia and graduates of the same programs from the previous two academic years (2020 and 2021). For sample selection, we used probabilistic sampling, especially stratified random sampling—a technique that ensures that every individual in the population has the same probability of being included in the sample. The study population was divided into subgroups or strata, which all shared a similar characteristic: being academic programs offered by the faculty of engineering at the ITM. The senior students and graduates of each academic program or stratum were selected randomly, which allowed us to estimate the sample size per academic program. Table 1 shows the population and sample of senior students and graduates per academic program.

**Table 1: Population and Sample of Senior Students and Graduates per Academic Program**

Program	Graduates			Students		
	Population	Sample	Strata	Population	Sample	Strata
Systems engineering	273	91	35.55%	95	50	27.20%
Electronic engineering	64	21	8.20%	57	30	16.32%
Mechatronics engineering	146	48	18.75%	86	45	24.62%
Telecommunications engineering	158	53	20.70%	71	37	20.33%
Electromechanical engineering	129	43	16.80%	41	21	11.74%
<b>TOTAL</b>	<b>770</b>	<b>256</b>	<b>100%</b>	<b>350</b>	<b>183</b>	<b>100%</b>

A total of 505 respondents participated in the study. However, after discarding the questionnaires with missing data due to participants’ lack of work experience, only 470 questionnaires were considered for analysis. Out of the 505 respondents, 86.1% were men, and 13.9% were women. According to the ITM’s academic information system, 6,112 students were enrolled in these engineering programs in 2021, with 12.2% of them being women. Additionally, there were 495 graduates, and 16.6% of them were women. Half of the population were between 26 and 35 years of age, and only 6% were aged over 45. Probably because the population was younger, 58.8% were single. In terms of socioeconomic strata (with 1 representing a very low socioeconomic status, 2 a low socioeconomic status, 3 a middle-to-low socioeconomic status, 4 a middle socioeconomic status, 5 a middle-to-high socioeconomic status, and 6 a high socioeconomic status), 85.2% of respondents

belonged to socioeconomic strata 1, 2, and 3, whereas 14.8% came from strata 4 to 6. This is consistent with information provided by HEIs in Colombia regarding the student population, which shows that 86.5% of students come from socioeconomic strata 1, 2, and 3 (Noreña Jaramillo and Rincón Laverde, 2018). Table 2 shows the population and sample of senior students and graduates per academic program.

**Table 2: Distribution of the Global Sample of Students and Graduates by Sociodemographic Variables**

Sociodemographic variables		Total population		Senior students		Graduates	
		n	%	n	%	n	%
Gender	Male	435	86.1%	174	34.5%	261	51.7%
	Female	70	13.9%	25	5.0%	45	8.9%
Age	15–25 years	87	17.2%	72	14.3%	15	3.0%
	26–35 years	253	50.1%	89	17.6%	164	32.5%
	36–45 years	134	26.5%	33	6.5%	101	20.0%
	Over 45 years	31	6.1%	5	1.0%	26	5.1%
Marital status	Single	297	58.8%	145	28.7%	152	30.1%
	Married	104	20.6%	23	4.6%	81	16.0%
	Cohabiting	100	20.0%	30	5.9%	70	14.1%
	Separated	3	0.6%	1	0.2%	2	0.4%
Socioeconomic stratum	1	28	5.5%	18	3.6%	10	2.0%
	2	162	32.1%	91	18.0%	71	14.1%
	3	242	47.9%	81	16.0%	161	31.9%
	4	65	12.9%	8	1.6%	57	11.3%
	5	5	1.0%	0	0.0%	5	1.0%
	6	3	0.6%	1	0.2%	2	0.4%

Note: n = frequency, % = percentage.

Regarding employment status, most senior students (69%) and graduates (90%) were employed at the time of the analysis, which suggests a low unemployment rate—approximately 10% in both cases. Furthermore, 18% of the student population lacked work experience. This information is further supported by details on the type of employment contract, salary, working hours, and size and reach of the company. As observed in Table 3, 31.7% of senior students and 42.5% of graduates worked for international companies. In addition, 24.6% of senior students and 42.5% of graduates were employed in companies classified as very large based on the number of employees. Concerning salary, 47.8% of senior students earned between 1 and 3 times the minimum wage, while 33.6% of graduates earned between 3 and 5 times the minimum wage. Moreover, 49.7% of senior students and 67.6% of graduates held or had held indefinite-term contracts. Lastly, 69.8% of senior students and 89.2% of graduates worked a full-time schedule. These figures reflect favourable employment conditions.

**Table 3: Employment Characteristics of the Population**

	Characteristics	Senior students		Graduates	
		n	%	n	%
<b>Reach of the company</b>	No work experience	35	17.6%	0	0.0%
	International company	63	31.7%	130	42.5%
	Local company	41	20.6%	65	21.2%
	National company	53	26.6%	95	31.0%
	Regional company	7	3.5%	16	5.2%
<b>Size of the company</b>	No work experience	35	17.6%	0	0.0%
	Large company: 250–999 employees	36	18.1%	66	21.6%
	Medium-sized company: 50–249 employees	37	18.6%	48	15.7%
	Very large company: 1.000 or more employees	49	24.6%	130	42.5%
	Small company: 1 0–49 employees	24	12.1%	31	10.1%
	Microenterprise: less than 10 employees	18	9.0%	31	10.1%
<b>Type of contract</b>	Fixed-term contract	26	13.1%	45	14.7%
	Indefinite-term contract	99	49.7%	207	67.6%
	Contractor	14	7.0%	32	10.5%
	Apprenticeship contract	4	2.0%	0	0.0%
	Unemployed	3	1.5%	3	1.0%
	Freelancer	1	0.5%	1	0.3%
	N/A	38	19.1%	1	0.3%
	Temporary contract	14	7.0%	17	5.6%
<b>Salary</b>	No work experience	35	17.6%	0	0.0%
	Between 0 and 1 times the minimum wage	28	14.1%	15	4.9%
	Between 1 and 2 times the minimum wage	61	30.7%	49	16.0%
	Between 2 and 3 times the minimum wage	34	17.1%	71	23.2%
	Between 3 and 4 times the minimum wage	27	13.6%	72	23.5%
	Between 4 and 5 times the minimum wage	6	3.0%	31	10.1%
	Between 5 and 6 times the minimum wage	5	2.5%	27	8.8%
	More than 6 times the minimum wage	3	1.5%	41	13.4%
<b>Work schedule</b>	No work experience	1	0.5%	0	0.0%
	Unemployed	1	0.5%	0	0.0%
	N/A	38	19.1%	5	1.6%
	Some hours	13	6.5%	19	6.2%
	Full time	139	69.8%	273	89.2%
	Part time	7	3.5%	9	2.9%

Table 4 shows some employment-related factors that are thought to influence employability. As can be seen, 30.1% of senior students and 51.3% of graduates had received one or more promotions. In terms of the education–job relationship, which was measured on a scale from 1 to 5, with 5 indicating a very strong relationship, 48.7% of senior students and 67.0% of graduates had engaged in jobs that align with their field of study, giving it a rating of 4 and 5. Additionally, 57.8% of senior students and 71.9% of graduates exhibited a level of job performance classified as adequately qualified, indicating that their knowledge and skills reasonably matched the requirements of their jobs.

**Table 4: External Aspects Related to Employability**

	Characteristics	Senior students		Graduates	
		n	%	n	%
Number of promotions	No work experience	35	17.6%	0	0.0%
	1	26	13.1%	73	23.9%
	2	15	7.5%	38	12.4%
	More than 2	19	9.5%	46	15.0%
	None	104	52.3%	149	48.7%
Education–job relationship	No work experience	35	17.6%	0	0.0%
	1	14	7.0%	21	6.9%
	2	18	9.0%	23	7.5%
	3	35	17.6%	57	18.6%
	4	49	24.6%	76	24.8%
	5	48	24.1%	129	42.2%
Level of job performance	No work experience	35	17.6%	0	0.0%
	Underqualified	25	12.6%	51	16.7%
	Adequately qualified	115	57.8%	220	71.9%
	Overqualified	24	12.1%	35	11.4%

### Measurement instrument

The designed questionnaire included a total of 81 questions. Specifically, 72 questions aimed to measure the dependent variables: 35 for internal factors—considered the most important in this study—16 for external factors, and 21 for career development. Additionally, 4 were intended to measure the independent variables (education–job relationship, level of job performance, number of promotions, and employment status), and 4 to collect participants’ sociodemographic information (e.g., age, gender, socioeconomic stratum, and marital status).

### Internal factors

Regarding internal factors, we considered individuals’ social and emotional competences, employability skills, and perception of the internal and external labour market. Social and emotional competences were measured using the following seven competences from the Emotional Competence Framework proposed by Goleman (1995): emotional self-awareness, teamwork, emotional self-control, personality traits (motivation and empathy), achievement drive, persuasion, and assertive communication. On a five-point Likert scale, respondents indicated the degree to which they displayed every behaviour (e.g., ‘I respect the decisions made by the group’). The reliability of this scale ( $\alpha = 0.70$ ) was comparable to that reported in previous studies (Ceballos et al., 2017). Employability skills were assessed using five factors suggested by Fugate and Kinicki (2010): work and career proactivity, career motivation, work and career resilience, Openness to changes at work and optimism at work. To these factors, we added professional knowledge (Bennett and Ananthram, 2021). Using a five-point Likert scale, respondents rated the extent to which they had displayed these behaviours in the workplace (e.g., ‘I apply the knowledge and skills acquired during my undergraduate studies in the workplace’). In this case, the Cronbach’s alpha was between 0.70 and 0.86. Finally, we adapted the items of the scales developed by De Cuyper et al. (2008) to evaluate graduates’ and

students' perception of their position in the labour market both with their current employer and with other employers.

### **External factors**

Concerning external factors, we took into account three variables as supported by previous studies (Rothwell et al., 2008; Van Dam, 2004): organizational support, the impact of the university, and support from the university. Organizational support was measured based on the notion proposed by Van Dam (2004). On a five-point Likert scale, respondents indicated the extent of the support they received from their employers to carry out their duties, gain expertise, and be promoted (e.g., 'My employer makes an effort to provide employees with the resources they need to do their work properly'). The reliability of this scale was high, with a Cronbach's alpha of 0.84. The perceived impact of the university was evaluated using an adapted version of the questionnaire designed by Rothwell et al. (2008). Using a five-point Likert scale, respondents rated the strength of their university's brand and reputation in the engineering sector (e.g., 'The status of my university is a great asset in my search for employment'). The internal reliability coefficient of this scale was 0.75. Finally, the support from the university was assessed based on the actions that universities take to increase the employability of their graduates (e.g., 'My university encourages students to participate in career guidance activities, providing opportunities to learn essential skills such as CV writing, self-assessment tests, interview skills, and career planning; 'My university offers courses designed to develop specific, up-to-date career content').

### **Career development**

For career development, which was divided into self-awareness and career awareness, we employed the scale developed by Bennett et al. (2021) to examine individuals' perception of their academic preparation and strengths, as well as their feelings about fusing theory and practice in the workplace (e.g., 'The training you received closely aligns with the demands of your employer'). Career success was measured using three traditional indicators: salary, promotions, and relevant hierarchical positions. The data were collected using a five-point Likert scale with responses ranging from '1 = considerably below my colleagues' to '5 = considerably above my colleagues.' The Cronbach alpha of this scale was 0.86. To evaluate this variable more thoroughly, we included the following two social capital-related items suggested by Verbruggen and Sels (2009): 'I know people who can help me with my career' and 'I can establish and maintain contact with people who can help me with my career.' The Cronbach alpha in this case was 0.90. Career commitment was measured using four of the nine items proposed by Rothwell and Arnold (2007) (e.g., 'I am glad I chose this career path over others I was considering at the time I enrolled at the university'). In this case, the response options were identical to those in the other scales, and the internal reliability coefficient was 0.80. Finally, job satisfaction was measured using the items suggested by Chew and Chan (2008) (e.g., 'My current job meets my career expectations'). The response options for this scale were the same as in the previous ones, and the internal reliability coefficient was 0.80.

### **Data analysis**

We performed a descriptive analysis using frequency distributions and cross tabulation. Additionally, we computed the mean and standard deviation of each quantitative variable, including the mean ratings of workplace behaviours, the level of support from employers and the university, the impact of the university, and individuals' perceptions of their academic preparation and strengths. Also, we conducted a differential analysis via the Student's t-test, with *academic program* as the independent variable. Finally, besides employing Analysis of Variance (ANOVA) to examine the interaction between the independent variables and factors such as career commitment, organizational support, and job satisfaction, we estimated the value of the Student's t-test, the F in ANOVA, the probability associated with these values (p), and the degrees of freedom (df). The data were statistically processed using IBM SPSS (version 26) for Windows.

## Results

### Descriptive analysis

Through this analysis, we were able to describe the sample's characteristics regarding the independent variables (education–job relationship, level of job performance, number of promotions, and employment status). In addition, it allowed us to analyse the means of the dependent variables (classified into three factors) for each independent variable in order to identify those with the highest means, as observed in Table 5, 6 and 7.

**Table 5: Mean and Standard Deviation of the Internal Factors' Variable per Academic Program**

Independent variables	Internal factors			
	Employability skills	Social and emotional competences	Internal and external labour market	
Education–job relationship	1 = no relationship (35)	3.825 (0.779)	3.818 (0.568)	2.869 (0.678)
	2 (41)	3.983 (0.563)	3.879 (0.445)	3.084 (0.797)
	3 (92)	3.867 (0.585)	3.861 (0.451)	3.169 (0.670)
	4 (125)	4.183 (0.453)	3.848 (0.394)	3.402 (0.698)
	5 = strong relationship (177)	4.365 (0.555)	4.002 (0.475)	3.605 (0.777)
Number of promotions	None (253)	4.039 (0.607)	3.865 (0.481)	3.216 (0.746)
	1 promotion (99)	4.186 (0.587)	3.932 (0.407)	3.548 (0.727)
	2 promotions (53)	4.164 (0.504)	3.921 (0.429)	3.388 (0.605)
	3 promotions (65)	4.483 (0.469)	4.033 (0.458)	3.651 (0.877)
Level of job performance	1= underqualified (77)	4.024 (0.619)	3.834 (0.509)	3.213 (0.691)
	2 = adequately qualified (334)	4.211 (0.546)	3.940 (0.433)	3.464 (0.741)
	3 = overqualified (59)	3.931 (0.729)	3.832 (0.521)	3.010 (0.860)
Employment status	1 = no work experience (35)	N/A	3.837 (0.389)	N/A
	2 = employed (413)	4.191 (0.560)	3.935 (0.438)	3.404 (0.759)
	3 = unemployed (57)	3.818 (0.710)	3.718 (0.558)	3.090 (0.761)

**Table 6: Mean and Standard Deviation of the External Factors' Variable per Academic Program**

Independent variables	External factors			
	Impact of the university	Organizational support	Support from the university	
<b>Education–job relationship</b>	1 = no relationship (35)	3.097 (1.040)	3.028 (1.039)	2.902 (0.969)
	2 (41)	3.362 (0.686)	3.518 (1.030)	3.132 (0.922)
	3 (92)	3.390 (0.717)	3.421 (0.890)	3.090 (0.912)
	4 (125)	3.646 (0.756)	3.712 (0.974)	3.447 (0.877)
	5 = strong relationship (177)	3.829 (0.728)	4.031 (0.845)	3.584 (0.994)
<b>Number of promotions</b>	None (253)	3.536 (0.732)	3.440 (1.035)	3.334 (0.965)
	1 promotion (99)	3.693 (0.836)	3.985 (0.798)	3.374 (0.975)
	2 promotions (53)	3.518 (0.899)	3.825 (0.723)	3.313 (0.939)
	3 promotions (65)	3.769 (0.805)	4.231 (0.733)	3.484 (0.982)
<b>Level of job performance</b>	1= underqualified (77)	3.180 (0.825)	3.685 (0.950)	2.807 (0.897)
	2 = adequately qualified (334)	3.706 (0.710)	3.832 (0.910)	3.491 (0.912)
	3 = overqualified (59)	3.542 (0.967)	3.030 (1.029)	3.341 (1.093)
<b>Employment status</b>	1 = no work experience (35)	3.486 (0.489)	N/A	3.351 (0.681)
	2 = employed (413)	3.630 (0.770)	3.831 (0.914)	3.388 (0.960)
	3 = unemployed (57)	3.373 (0.882)	2.816 (0.874)	3.158 (0.987)

**Table 7: Mean and Standard Deviation of the Career Development Variable per Academic Program**

Independent variables		Career development			
		Career commitment		Job satisfaction	Career success
<b>Education–job relationship</b>	1 = no relationship (35)	3.892 (0.869)	3.16 (0.922)	2.514 (1.317)	2.314 (1.369)
	2 (41)	3.884 (0.698)	3.415 (0.692)	3.171 (1.190)	3.033 (1.271)
	3 (92)	3.995 (0.650)	3.559 (0.756)	3.328 (0.984)	2.924 (0.979)
	4 (125)	4.264 (0.597)	3.806 (0.737)	3.563 (1.074)	3.216 (1.035)
	5 = strong relationship (177)	4.412 (0.615)	4.007 (0.807)	3.821 (1.228)	3.629 (0.953)
<b>Number of promotions</b>	None (253)	4.138 (0.663)	3.677 (0.800)	3.421 (1.159)	2.822 (1.038)
	1 promotion (99)	4.255 (0.672)	3.781 (0.832)	3.584 (1.201)	3.424 (1.010)
	2 promotions (53)	4.212 (0.577)	3.779 (0.724)	3.626 (1.029)	3.717 (0.893)
	3 promotions (65)	4.392 (0.773)	3.976 (0.908)	3.594 (1.444)	4.133 (0.901)
<b>Level of job performance</b>	1= underqualified (77)	4.075 (0.663)	3.319 (0.773)	3.356 (1.188)	3.303 (1.276)
	2 = adequately qualified (334)	4.265 (0.648)	3.851 (0.774)	3.610 (1.191)	3.311 (1.034)
	3 = overqualified (59)	4.047 (0.801)	3.755 (0.943)	3.085 (1.152)	2.684 (1.144)
<b>Employment status</b>	1 = no work experience (35)	4.150 (0.529)	3.649 (0.521)	N/A	N/A
	2 = employed (413)	4.222 (0.679)	3.786 (0.814)	3.589 (1.196)	3.366 (1.047)
	3 = unemployed (57)	4.096 (0.651)	3.506 (0.814)	2.874 (1.008)	2.251 (1.055)

Note: N/A: The question does not apply because respondents reported not having any work experience.

After analysing the information shown in Table 5, 6 and 7, respondents who reported that their education and job were strongly related perceived a high level of development of employability skills ( $\bar{X} = 4.365$ ;  $\sigma = 0.555$ ) and career commitment ( $\bar{X} = 4.412$ ;  $\sigma = 0.615$ ). Likewise, those who had had up to three promotions perceived a high level of development of employability skills ( $\bar{X} = 4.483$ ;  $\sigma = 0.469$ ) and career commitment ( $\bar{X} = 4.392$ ;  $\sigma = 0.773$ ). Those who felt they were adequately qualified for their position obtained similar results in terms of employability skills ( $\bar{X} = 4.211$ ;  $\sigma = 0.546$ ) and career commitment ( $\bar{X} = 4.265$ ;  $\sigma = 0.648$ ), as did those who were employed: employability skills ( $\bar{X} = 4.191$ ;  $\sigma = 0.560$ ) and career commitment ( $\bar{X} = 4.222$ ;  $\sigma = 0.679$ ). Importantly, respondents who were unemployed reported that they lacked career success ( $\bar{X} = 2.251$ ;  $\sigma = 1.055$ ), adequate organizational support ( $\bar{X} = 2.816$ ;  $\sigma = 0.874$ ), and job satisfaction ( $\bar{X} = 2.874$ ;  $\sigma = 1.008$ ). Finally, those who stated that their job duties had nothing to do with their education had a low perception of the professional skills they possessed to be highly regarded by their current or another employer ( $\bar{X} = 2.314$ ;  $\sigma = 1.369$ ). Additionally, they claimed that they did not receive significant support from their university ( $\bar{X} = 2.092$ ;  $\sigma = 0.969$ ) and that they were not satisfied with their jobs ( $\bar{X} = 2.514$ ;  $\sigma = 1.369$ ).

## Differential analysis

We conducted a series of parametric tests, assuming normality and independence given the sample size and the use of accidental sampling (Reig-Aleixandre et al., 2022). To assess the homogeneity of the global questionnaire, we performed the Levene's test, whose results are presented in Table 8.

**Table 8: Results of the Levene's Test of Homogeneity of Variances**

	Levene's statistic	Equal variances	F	Sig.	$\eta^2$
<b>Employment status</b>	0.012	Yes (0.914)	45.404	0.000	0.017
<b>Number of promotions</b>	1.231	Yes (0.298)	15.618	0.000	0.017
<b>Education–job relationship</b>	1.106	Yes (0.353)	34.329	0.000	0.033
<b>Level of job performance</b>	1.388	Yes (0.251)	19.723	0.000	0.007

The ANOVA result for the different independent variables was found to be significant. Therefore, the null hypothesis is rejected, and it is confirmed that, although the effect size is small, there are significant differences in individuals' perceived level of employability depending on their employment status, number of promotions, education–job relationship, and level of job performance. Table 9 below shows these significant differences.

According to the ANOVA results, *awareness of the program* showed significant differences with the *level of job performance* ( $F = 13.938; p = 0.000$ ), with an effect size of 0.22, and with the *education–job relationship* ( $F = 13.170; p = 0.000$ ), with an effect size of 0.019. Also, there were significant differences between *support from the university* and the *education–job relationship* ( $F = 7.343; p = 0.000$ ). *Perception of the internal and external labour market* had significant differences with the *level of job performance* ( $F = 11.114; p = 0.000$ ), *number of promotions* ( $F = 8.509; p = 0.000$ ), the *education–job relationship* ( $F = 12.044; p = 0.000$ ), and *employment status* ( $F = 8.544; p = 0.004$ ). For its part, *organizational support* showed significant differences with the *level of job performance* ( $F = 18.614; p = 0.000$ ), the *education–job relationship* ( $F = 12.867; p = 0.000$ ), and *employment status* ( $F = 62.415; p = 0.000$ ). Job satisfaction had significant differences with the *education–job relationship* ( $F = 11.386; p = 0.000$ ) and *employment status* ( $F = 18.547; p = 0.000$ ). Career success showed significant differences with *number of promotions* ( $F = 37.242; p = 0.000$ ) and *employment status* ( $F = 56.696; p = 0.000$ ). *Employability skills* had significant differences with the *level of job performance* ( $F = 7.754; p = 0.000$ ) and *number of promotions* ( $F = 10.571; p = 0.000$ ). Finally, *social and emotional competences* showed significant differences with *employment status* ( $F = 6.277; p = 0.002$ ).

After performing Tukey's test, we may say that significant differences between the *level of job performance* and *perception of the internal and external labour market*, *organizational support*, and *employability skills* were observed in respondents who felt overqualified ( $p < 0.01$ ), whereas significant differences between the *level of job performance* and *awareness of the program* were observed in those who felt underqualified ( $p < 0.01$ ). Regarding *number of promotions* and its relationship with *perception of the internal and external labour market*, *career success*, and *employability skills*, significant differences were found in respondents who had had up to three promotions ( $p < 0.01$ ). As for the *education–job relationship*, significant differences were observed between respondents who scored such relationship with 1, 2, and 3 and those who scored it with 4 and 5 ( $p < 0.01$ ).

**Table 9: Differences Between the Employability Factors and the Independent Variables**

	Level of job performance				Number of promotions				Education–job relationship				Employment status			
	Levene	Sig.	F	Sig.	Levene	Sig.	F	Sig.	Levene	Sig.	F	Sig.	Levene	Sig.	F	Sig.
1	2.990	0.051	7.754	0.000	1.909	0.127	10.571	0.000	4.300	0.002	16.505	0.000	6.219	0.013	20.694	0.000
2	1.590	0.205	2.648	0.072	1.545	0.202	2.451	0.063	2.605	0.035	3.066	0.016	2.589	0.076	6.277	0.002
3	1.576	0.208	11.114	0.000	0.994	0.395	8.509	0.000	0.977	0.420	12.044	0.000	0.234	0.629	8.544	0.004
4	3.206	0.041	14.936	0.000	1.443	0.230	2.224	0.085	2.913	0.021	10.787	0.000	3.794	0.023	3.154	0.044
5	0.431	0.650	18.610	0.000	7.119	0.000	17.463	0.000	1.293	0.272	12.867	0.000	1.088	0.297	62.415	0.000
6	3.128	0.045	16.807	0.000	0.465	0.707	0.465	0.707	0.939	0.441	7.343	0.000	3.936	0.020	1.487	0.227
7	1.823	0.163	4.429	0.012	0.261	0.853	2.696	0.045	3.203	0.013	11.809	0.000	0.506	0.603	0.998	0.369
8	2.221	0.110	13.938	0.000	1.224	0.300	2.411	0.066	1.799	0.128	13.170	0.000	2.145	0.118	3.341	0.036
9	0.418	0.659	5.615	0.004	4.398	0.005	0.862	0.461	1.752	0.138	11.386	0.000	3.011	0.083	18.547	0.000
10	3.726	0.025	8.499	0.000	1.420	0.236	37.242	0.000	5.642	0.000	15.495	0.000	0.706	0.401	56.699	0.000

Note:

Internal factors:

1. Employability skills
2. Social and emotional competences
3. Perception of the internal and external labour market

External factors:

4. Impact of the university
5. Organizational support
6. Support from the university

Career development:

7. Career commitment
8. Awareness of the program
9. Job satisfaction
10. Career success

## Discussion

For Lo Presti et al. (2019), measuring the employability of professionals is a challenging task because, since it is a dynamic construct made up of multiple factors, it sparks debate. In fact, the various variables that depend on the employment context can lead to significant differences between the factors that make up employability. For instance, in this study, we observed significant differences between factors such as the support received from the university, the perception of the internal and external labour market, career success, and employability skills among graduates who perceived that their education and job were strongly related, had a high job performance, a high number of promotions, many years of experience, and were employed.

Graduates' perception of the internal and external labour market is influenced by their skills and self-confidence and thus may be more closely linked to personal efficacy beliefs (Rothwell et al., 2008). This means that graduates who have a high job performance, have had many promotions, see a strong connection between their education and job, and have a stable employment situation perceive that they may be highly regarded for the work they do with their current employer or another company. Also, they are more likely to get a more qualified position with their current or a similar employer. This set of intangible personal attributes, however, have become a barrier for universities that focus on traditional indicators (such as employment rates and technical skills) instead on helping students to develop their mind and character.

The research conducted by de Campos et al. (2020) emphasizes a fundamental concept: engineering education. This education goes beyond understanding traditional engineering concepts such as mechanics, dynamics, mathematics, and technology. It also involves the development of soft skills. In order to effectively address and resolve real-world situations, engineers must possess these skills, taking into account not only technical aspects but also political, social, environmental, and cultural factors. In this study, these skills were grouped into six categories: problem solving, communication, teamwork, ethical perspective, emotional intelligence, and creative thinking.

According to the results of this study, graduates perceived organisational support is associated with their level of job performance, the relationship between their education and job, and their employment status. This is in line with the findings of Van Dam (2004), who stated that organizations can influence employees' development and professional activities. They can do so by supporting employees in their careers and fostering a culture of learning and growth that allows them to overcome potential barriers and perform their assigned duties without changing their focus on developing employability. Additionally, such authors found that employees who received greater organizational support were happier with their jobs and thus less likely to consider changing jobs. In this study, openness to changes at work was the most highly rated skill. With regard to the support received from the university and the impact of the university, none was found to have a significant relationship with the independent variables. A similar result was obtained by Rothwell et al. (2008), who discarded the elements that had to do with the reputation of the university in the field of study and the status and credibility of the field of study because of their relatively weak relationship with the other components of employability.

Subjective career success is defined as the strength of a person's commitment to their chosen profession or vocation. In turn, this concept is associated with individuals' perceptions of the past, present, and future in light of the circumstances they are faced with—whether favourable (e.g., promotions or selection processes) or unfavourable (e.g., downsizing and career stagnation). In this study, this factor was assessed based on three aspects: salary increase, promotions, and relevant hierarchical positions over the previous three years. As indicated by Salt et al. (2010), when it comes to choosing a career, individuals prioritize salary and promotion opportunities over other variables.

In addition to its contributions to society and the field under investigation, it is important to acknowledge the limitations of this study. Since we employed a cross-sectional design, conclusions about causality could not be drawn. Addressing this issue would thus require the use of longitudinal

designs in future research. Also, future studies may consider employing observational methodology to look at how individuals with higher employability levels actually behave in the workplace. Such a design would make it possible to investigate potential mechanisms through which these concepts influence people's behaviours in the workplace. Furthermore, as the only source of information we used was the self-reported responses of the students and graduates—which relied on their self-perceptions—this could introduce common method bias. In addition, the use of a single source of information may have induced common method variance, leading to increased correlation coefficients between predictors and criteria. Therefore, future research is strongly encouraged to use objective measures or different sources of information, such as employing personnel records to assess employability activities.

## Conclusion

Based on these findings, it is crucial to understand that employability can vary over time and in space depending on individuals' experiences in the labour context and not on what one might expect: on the labour markets that are dominated by demonstrable and transferable experiences and skills.

Importantly, in order to meet the needs of the modern economy and society, engineering education needs to go beyond its technical and theoretical components. Having a solid technical knowledge alone is not enough; additional skills are also required to effectively address the challenges that arise in the field.

One of the strengths of this study is that it adopted a conceptual model of employability development characterized by a holistic perspective. In contrast to a narrow focus on skill and knowledge acquisition, the adapted framework comprehensively categorizes all facets of employability, exhibiting versatility applicable across the varied landscape of higher education. Moreover, we were able to identify indicators useful for discussing employability provision in higher education. While the suggested framework can be used to delve deeper into higher education achievements, additional conceptual work is required to understand the boundaries between individual factors. This study also makes a distinction between the specific capitals that can be classified as individual factors and those that should be treated as individual circumstances (level of job performance, number of promotions, education–job relationship, and employment status). In addition, in order to improve the employability of future workers, the responsibilities of various stakeholders—students, graduates, employers, educational institutions, and the government—should be reviewed and discussed. It is, however, crucial not to overlook the pivotal role of higher education in shaping well-rounded citizens.

Finally, it is essential to reflect upon and discuss the existing gap between engineering education, the labour market, and society's demands. Although this paper does not aim to provide a comprehensive answer to this question, it seeks to raise awareness within the scientific community and encourage reflection among businesses, education professionals, and current and future engineers. Future research should investigate whether graduates are employed in the field of engineering, and how this may affect their perception of the impact and support from the university when compared to senior students who have not yet left the institution.

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