

Impact of Developing Soft, Digital, and Research Skills on The Job Performance of Engineering Graduates: A Mixed-Sector Study in Peruvian Public Education

Carlos Andrés Guerra Bendezú¹, Rafael Vásquez Rodríguez², Victor Humberto Carranza Elguera³, Alberto Francisco Sánchez Camino⁴

¹ National University of Engineering, Lima, Peru.

² National University of Engineering, Lima, Peru.

³ National University of Engineering, Lima, Peru.

⁴ National University of Engineering, Lima, Peru.

¹cguerra@uni.edu.pe, ²rvasquezr@uni.edu.pe ³vcarranza@uni.edu.pe, ³asanchezc@uni.edu.pe

¹<https://orcid.org/0000-0002-8928-1237>, ²<https://orcid.org/0000-0001-8195-0638>, ³<https://orcid.org/0000-0002-3213-4076>, ³<https://orcid.org/0009-0004-0482-6464>

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ABSTRACT:

The objective of this research was to analyze how the development of soft, digital, and research skills influences the job performance of engineering graduates trained at a Peruvian public university. To this end, a mixed sequential explanatory design was used to articulate quantitative and qualitative evidence based on the graduates' experience. In the quantitative phase, 600 graduates participated, responding to a Likert-type questionnaire to assess their levels of cross-cutting skills and their self-perception of professional performance. With this information, an ordinal logistic regression model was estimated to identify the predictive weight of each skill. Subsequently, in the qualitative phase, 125 of these participants answered open-ended questions aimed at delving deeper into the educational and work experiences associated with the use of these competencies. The analysis was performed using first- and second-cycle thematic coding. The results show that research competencies have the greatest impact on the probability of achieving high levels of job performance, followed by soft skills and, to a lesser extent, digital competencies. The negative coefficients recorded for low levels in each competency indicate that when these are not adequately developed, the possibility of superior professional performance decreases significantly. Complementarily, the qualitative narratives reveal gaps in leadership, communication, use of specialized software, research methodology, and practical experience, forcing many graduates to resort to self-training to respond to market demands. It is concluded that optimal job performance depends on the balanced development of the three competencies analyzed. In turn, the need to modernize the curriculum, strengthen practical training, and improve university-business links is highlighted in order to close gaps in job relevance and enhance the employability of graduates.

Keywords: Soft skills, Digital skills, Research skills, Job performance, Engineering education.

1) Introduction

In the current context, professional work takes place in an environment marked by automation, digitization, and the rapid obsolescence of knowledge. International reports indicate that, in order to face these changes, it is no longer enough to master technical content: people need to combine specialized knowledge with socio-emotional, digital, and analytical skills that allow them to learn continuously and adapt to uncertain scenarios [1]. This perspective places cross-cutting competencies at the center of the debate on the quality of higher education and the job performance of graduates, especially in fields such as engineering, which are closely linked to technological innovation processes.

From a competency-based approach, professional training is conceived as a comprehensive process that articulates knowledge, skills, attitudes, and values to act effectively in real situations [2]. This approach suggests that a competent engineer is not only someone who solves equations or designs systems, but also someone who knows how to communicate their ideas, work with others, make informed decisions, and learn from experience. Along these lines, Tobón emphasizes that professional competencies are always situational and complex in nature, and that their development requires a shift from content-centered teaching to education oriented toward problems and challenges in the context [2]. This vision is particularly relevant for public universities seeking to improve the social relevance of their programs and the employability of their graduates.

Recent literature has placed particular emphasis on cross-cutting competencies that promote employability. A systematic review based on the perspective of employers shows that, when evaluating university graduates, they attach great importance to competencies such as communication, teamwork, problem solving, responsibility, and adaptability, even above some specific disciplinary knowledge [3]. These findings suggest that the transition from university to the labor market depends largely on how educational programs manage to combine

technical skills with the development of personal and social skills.

Several studies have analyzed the role of soft skills in the employability of graduate students. Martínez-Gómez and Nicolalde found that participation in research projects and active methodologies favors the simultaneous development of technical and soft skills, such as leadership, responsibility, and collaborative work, improving the perception of employability among engineering students [4]. Complementarily, Sanz-Angulo and his collaborators showed that strategies such as flipped learning, cooperative work, and gamification significantly increased skills such as communication, time management, and collaboration in industrial engineering contexts [5]. Taken together, this evidence supports the idea that soft skills are not accessories to the curriculum, but central components of professional performance.

At the same time, digital transformation has greatly changed engineering practice and the working conditions of graduates. The OECD points out that digital competence is now a basic requirement for participating in highly technologized labor markets, as a large part of the tasks rely on data management, specialized software, collaborative platforms, and automation systems [1]. Along these lines, Panxhi and colleagues show that digital transformation initiatives in higher education institutions are linked to better employment prospects for engineering students, especially when these initiatives are accompanied by strategies to develop technological and entrepreneurial skills [6]. The authors conclude that the digitization of education, if managed properly, can become a factor that strengthens professional preparation and job opportunities.

Other studies delve deeper into the nature of these digital skills. Pelaez-Sanchez and colleagues analyze the role of digital skills in scenarios associated with Industry 5.0 and argue that, in addition to the instrumental use of tools, students need to be able to use technology ethically, critically, and creatively [7]. From this perspective, digital competence integrates dimensions such as information management, communication in virtual environments, content creation, security,

and network collaboration. Ortiz-Colón and his team, from the university sphere, emphasize that these skills do not develop spontaneously: they require clear training policies, teaching support, and experiences that allow students to use digital technologies to solve real problems [3,9].

Despite their importance, research shows significant gaps in the development of digital skills among university students, particularly in Latin American contexts. Martínez Navarro, in a study with students from five countries in the region, found that self-perceived digital competence varies across different areas, with information literacy being the most successful dimension and communication one of the weakest [10].

From a socio-formative perspective, research is understood as a practice that helps students learn to analyze complex problems, formulate hypotheses, select evidence, and justify decisions [2]. Recent studies in engineering education show that participation in research projects promotes the development of skills such as critical thinking, argumentation, creativity, and systematic problem solving, qualities closely linked to job performance and the ability to take on innovation responsibilities within organizations [4]. In this sense, research skills can be considered a bridge between academic training and continuous improvement in the workplace.

The transformation of engineering programs toward competency-based models has been the subject of reflection and concrete proposals. Impagliazzo and Xu analyze experiences of curricular reform in computer science and engineering and conclude that the transition to competency-based education requires redefining graduate profiles, reorganizing content around learning outcomes, and strengthening the authentic assessment of professional skills [9].

In this scenario, the problematic situation that motivates this study is linked to the possible gap between what public universities, particularly in the Peruvian context, manage to develop in their students and the competencies that the labor market demands of engineering graduates. On the one hand, curricula continue to offer solid technical training; on the other hand, international and regional evidence indicates that

companies increasingly value soft, digital, and research skills as decisive factors in professional performance [3,4,6–8,10]. Gaps in these skills can translate into difficulties in entering the labor market, reduced ability to adapt to digitized work environments, and limitations in participating in innovation processes within organizations. In this regard, the research aims to provide useful empirical evidence to guide curricular and academic management decisions, helping engineering education to respond more directly to the demands of an increasingly digital, collaborative, and innovation-oriented labor market.

2) Methods and Methodology

The study was developed using a mixed approach with a sequential explanatory design, with the aim of broadly understanding the role that soft, digital, and research skills play in the job performance of graduates from different engineering faculties. This type of design, described by Creswell and Plano Clark as one of the most appropriate when seeking to gain an in-depth understanding of the phenomenon through the analysis of quantitative information supplemented by qualitative information, is organized into two successive phases: a first quantitative phase and a second qualitative phase that helps to interpret the initial findings [11].

In the first phase, a structured questionnaire with closed questions was administered to 600 engineering graduates who had left university at least one year previously. This stage provided numerical data on the level of development of their soft, digital, and research skills, as well as indicators of their performance in the workplace. In the second phase, 125 of these participants—who had previously responded to the quantitative part—completed a survey with open-ended questions, aimed at gaining a deeper understanding of their perceptions, experiences, and assessments of the development and use of these skills in their work.

The reference population consisted of graduates from different engineering specialties at a public university in Peru. For the quantitative phase, quota sampling was used, achieving the participation of 600 graduates who met the

criterion of having graduated from the university at least one year prior. In the qualitative phase, 125 graduates were selected proportionally from among those who had completed the closed questionnaire. This criterion allowed for consistency between the two phases, as the people interviewed qualitatively were part of the same sample, which is consistent with Creswell's recommendations for sampling in sequential mixed studies [11].

Two digital questionnaires were used for the study. The first instrument consisted of a set of closed-ended questions on a five-point Likert scale, aimed at assessing the perceived level of soft, digital, and research skills, as well as various items related to job performance. The second instrument consisted of open-ended questions designed to gather graduates' opinions, stories, and experiences on how they apply these skills in their professional environment, what difficulties they encounter, and what aspects they believe the university should improve.

To collect the data, the link to the digital questionnaire was disseminated through institutional channels (email, alumni networks, and official university platforms). In the first stage, participants completed the survey with closed questions corresponding to the quantitative phase. Once this process was completed, 125 graduates who had responded to the survey were selected and invited to participate in the second, qualitative phase. This group was sent a second form with open-ended questions, accompanied by a brief explanation of the objectives of this stage and assurances of confidentiality.

The quantitative analysis began with the preparation of frequency tables and descriptive statistics to characterize the sample and examine the levels of assessment of soft, digital, and research skills, as well as job performance indicators. Subsequently, an ordinal logistic regression model was applied to identify the effect of soft, digital, and research skills on the ordered levels of job performance reported by graduates. This type of model is appropriate when the dependent variable is organized into hierarchical categories (e.g., low, medium, and high performance) and allows for estimating the

probability that a graduate will be placed in higher categories based on their skill levels.

In general terms, the model was set up as follows:

$$\log \log \left(\frac{P(Y=j)}{P(Y>j)} \right) = \theta_j - \beta_1 X_{blandas} - \beta_2 X_{digitales} - \beta_3 X_{investigativas} \dots (1)$$

where Y represents the level of job performance, j indicates each cut-off point between categories, θ_j are the thresholds of the model, and β_1 , β_2 , β_3 are the coefficients associated with soft, digital, and research skills, respectively.

The analysis of the open-ended responses was carried out following Johnny Saldaña's guidelines on qualitative coding [12]. In the first stage, a first-cycle coding was carried out, in which significant words, phrases, and fragments related to the development and use of soft, digital, and research skills at work were identified. Descriptive and thematic codes were mainly used, which allowed the central ideas expressed by the graduates to be labeled. In a second stage, a second-cycle coding was carried out, grouping the initial codes into broader categories that represented recurring patterns. This phase responded to Saldaña's proposal to move from codes closer to the text to conceptual categories that allow the meaning of the data to be interpreted and more integrated explanations to be constructed [12].

Finally, the quantitative and qualitative results were integrated, consistent with the sequential explanatory design of mixed methods. In the first stage, the results of the ordinal logistic regression were interpreted to identify general patterns of relationship between competencies and job performance. In the second stage, these findings were contrasted with the categories emerging from the qualitative analysis, seeking points of convergence, divergence, and complementarity. Following Creswell and Plano Clark, this integration phase allowed us to explain the numerical results in light of the specific experiences reported by the graduates, enriching our understanding of the phenomenon and offering a more complete view of how the competencies analyzed influence job performance [11].

3] Results:

Table 1 shows the distribution of soft skill levels reported by the 600 graduates surveyed. It can be seen that the majority report having a high or very high level of these competencies: 43.7% are at the high level and 20.7% at the very high level, together representing nearly two-thirds of the sample (64.4%). Twenty-five percent of participants are at an average level, while only 8.3% report a low level and 2.3% a very low level.

Table 1 Soft skills

Level	Frequency	Percentage	Cumulative percentage
Very low	14	2.3	2.3
Low	50	8.3	10.7
Moderate	150	25.0	35.7
High	262	43.7	79.3
Very high	124	20.7	100.0
Total	600	100.0	

Table 2 shows the distribution of digital competency levels among the 600 graduates surveyed. It can be seen that the majority are at high and very high levels: 45.3% report a high level ($n = 272$) and 20.8% a very high level ($n = 125$), accounting for approximately two-thirds of the sample (66.1%). Twenty-two point two percent of graduates ($n = 133$) are at an average level of digital skills, while only 8.3% ($n = 50$) report a low level and 3.3% ($n = 20$) a very low level.

Table 2 Soft skills

Level	Frequency	Percentage	Cumulative percentage
Very low	20	3.3	3.3
Low	50	8.3	11.7
Moderate	133	22.2	33.8
High	272	45.3	79.2
Very high	125	20.8	100.0
Total	600	100.0	

Table 3 shows the distribution of research skills levels reported by the 600 graduates. There is a significant concentration at the higher levels: 47.8% of participants are at the high level and 20.5% at the very high level. Overall, this means that approximately two-thirds of the sample (68.3%) perceive themselves as having developed research skills, such as the ability to analyze information, pose problems, and seek informed solutions. Twenty-one point two percent of graduates are at an average level, indicating a group that has acceptable foundations but still has room to strengthen this dimension. In contrast, the lower levels account for a small proportion of cases: 8.3% are at a low level and only 2.2% at a very low level, totaling 10.5% of participants with limited research skills.

Table 3 Research skills

Level	Frequency	Percentage	Cumulative percentage
Very low	13	2.2	2.2
Low	50	8.3	10.5
Moderate	127	21.2	31.7
High	287	47.8	79.5
Very high	123	20.5	100.0
Total	600	100.0	

Table 4 shows the distribution of job performance levels reported by the 600 participating graduates. In this regard, most were in the highest levels of this variable. Forty-five point two percent of the graduate web ts indicated high performance, while 14.8% were at the very high level, together accounting for nearly 60% of the sample. This indicates that, in general, graduates perceive their professional performance to be positive and that they respond adequately to the demands of their work environment. Twenty-nine point seven percent of participants were rated as average. On the other hand, the lowest levels of performance are in the minority, with only 7.8% reporting a low level and 2.5% reporting a very low level. Although they represent a small proportion, these results show

that there is a group that faces difficulties in performing their job duties adequately.

Table 4 Job performance

Level	Frequen cy	Percenta ge	Cumulati ve percentag e
Very low	15	2.5	2.5
Low	47	7.8	10.3
Average	178	29.7	40.0
High	271	45.2	85.2
Very high	89	14.8	100.0
Total	600	100.0	

Results of the ordinal logistic regression model

To analyze the influence of soft, digital, and research skills on job performance levels, an ordinal logistic regression model was estimated. The model showed an adequate fit and allowed us to identify which skills have the greatest predictive power over the probability of achieving higher levels of performance as reported by graduates.

Model information

To analyze the influence of soft, digital, and research skills on job performance levels, an ordinal logistic regression model was estimated. Before interpreting the effects of each skill, the overall fit of the model was evaluated. The results showed that the final model significantly improved on the model with only intercepts ($\chi^2 = 308.734$; $df = 12$; $p < 0.001$), indicating that the competencies analyzed provide significant explanatory power in predicting job performance.

Table 5 Job performance

Model	Log- likeliho od -2	Chi- square	gl	Sig.
Only intersecti on	686,303			
End	377,569	308,73 4	1 2	0.00 0

Goodness of fit

Goodness-of-fit tests confirmed that the model adequately represents the observed data. The Pearson test showed a p-value of 0.051 and the Deviance test showed a p-value of 0.997, both greater than the threshold of 0.05. This means that there are no significant differences between the observed values and those expected by the model, which supports the relevance of the fit.

Table 6 Goodness of fit

Model	Log likelihood -2	Chi-square	gl	Sig.
Only intersection	686,303			
End	377,569	308,734	12	0.000

Pseudo R²

The pseudo R² values allow us to estimate the proportion of variability explained by the independent variables in nonlinear models. The values obtained show that the model has adequate explanatory power: the Cox and Snell coefficient reached 0.402, while Nagelkerke's coefficient, which adjusts the scale to allow values close to 1, was 0.435. For its part, the McFadden coefficient registered a value of 0.199, considered acceptable

for logit-type models. Soft, digital, and research skills explain a significant proportion of the changes in job performance levels reported by graduates.

Table 7 Goodness of fit

Cox and Snell	0.402
Nagelkerke	0.435
McFadden	0.199

Estimates of the ordinal logit model parameters

The results show significant estimates in most of the categories included, indicating that the competencies assessed are relevant to the probability of achieving higher levels of performance. First, the thresholds associated with each job performance category were highly significant, with p-values less than 0.001 at levels 1, 2, and 3. Only the threshold for level 4 did not show statistical significance ($p = 0.474$), indicating that this transition point does not present substantial differences within the model. In terms of soft skills, taking the highest level (level 5) as a reference, levels 1 to 4 show negative and statistically significant coefficients. These coefficients range from -2.678 ($p < 0.001$) at level 1 to -0.600 ($p = 0.017$) at level 4. This means that graduates with lower levels of soft skills development are less likely to achieve higher levels of job performance.

Similar results were identified in digital skills. Levels 1, 2, and 3 showed significant negative coefficients (-2.477 , -1.196 , and -0.872 , respectively; $p < 0.01$), indicating that lower

digital scores reduce the probability of achieving better performance. Level 4 was not significant ($p = 0.135$), although its coefficient maintains the negative trend. This suggests that, although digital competence influences performance, the difference between medium and high levels is not as marked as in soft or investigative competencies.

Finally, investigative competencies showed the most intense effects within the model. The coefficients for levels 1 to 4 were the highest (-4.320 to -1.148 , all with $p < 0.001$), indicating that graduates with lower research skills are considerably less likely to achieve higher levels of job performance.

The results show that lower levels of soft, digital, and research skills are consistently associated with a lower probability of achieving high job performance. Research skills have the strongest effects, followed by soft skills and, to a lesser extent, digital skills. This confirms that the comprehensive development of these skills has a significant impact on the professional performance of engineering graduates.

Table 8 Parameter estimates of the ordinal logit model

Category/Variable	Estimate	Std. Error	Wald	df	Sig.	95% CI	
						Lower limit	Upper limit
Thresholds							
Job performance: Level 1	-7,797	0.462	284,414	1	0.000	-8,703	-6,890
Job performance: Level 2	-5,546	0.322	296,288	1	0.000	-6,178	-4,915
Job performance: Level 3	-3,034	0.264	132,172	1	0.000	-3,551	-2,517
Job performance: Level 4	-0.153	0.214	0.513	1	0.474	-0.572	0.266
Soft skills (ref. level 5)							
Level 1	-2,678	0.680	15,517	1	0.000	-4,011	-1,346
Level 2	-1,927	0.418	21,253	1	0.000	-2,746	-1,108
Level 3	-1,277	0.302	17,878	1	0.000	-1,869	-0.685
Level 4	-0.600	0.252	5.656	1	0.017	-1.094	-0.105
Digital skills (ref. level 5)							
Level 1	-2.477	0.589	17,670	1	0.000	-3,633	-1,322
Level 2	-1,196	0.402	8,846	1	0.003	-1,984	-0.408
Level 3	-0.872	0.317	7.584	1	0.006	-1.493	-0.251
Level 4	-0.383	0.256	2.233	1	0.135	-0.885	0.119
Research skills (ref. level 5)							

Level 1	-4.320	0.694	38,717	1	0.000	-5,680	-2,959
Level 2	-2,279	0.384	35,196	1	0.000	-3,032	-1,526
Level 3	-1,772	0.293	36,444	1	0.000	-2,347	-1,196
Level 4	-1,148	0.246	21,824	1	0.000	-1,629	-0.666

Qualitative results

The qualitative analysis sought to understand how skills impact the job performance of graduates from the public university under study. The opinions revealed that soft, digital, and research skills are important aspects for job placement and professional performance; however, they also highlighted multiple training gaps that graduates perceived when entering the job market.

First, the narratives highlight the underdevelopment of soft skills at graduation, especially in areas such as leadership, effective communication, collaborative work, and confidence in presenting ideas. These issues limit social interaction and the development of practical skills. In the workplace, these limitations ultimately led to difficulties in presenting projects, leading teams, or adapting to interdisciplinary environments.

With regard to digital skills, participants pointed to a clear gap between the tools taught at university and those demanded by the labor market. They mentioned courses based on obsolete software, limited practice with modern tools (BI, programming, modeling), and teachers who are not always up to date with

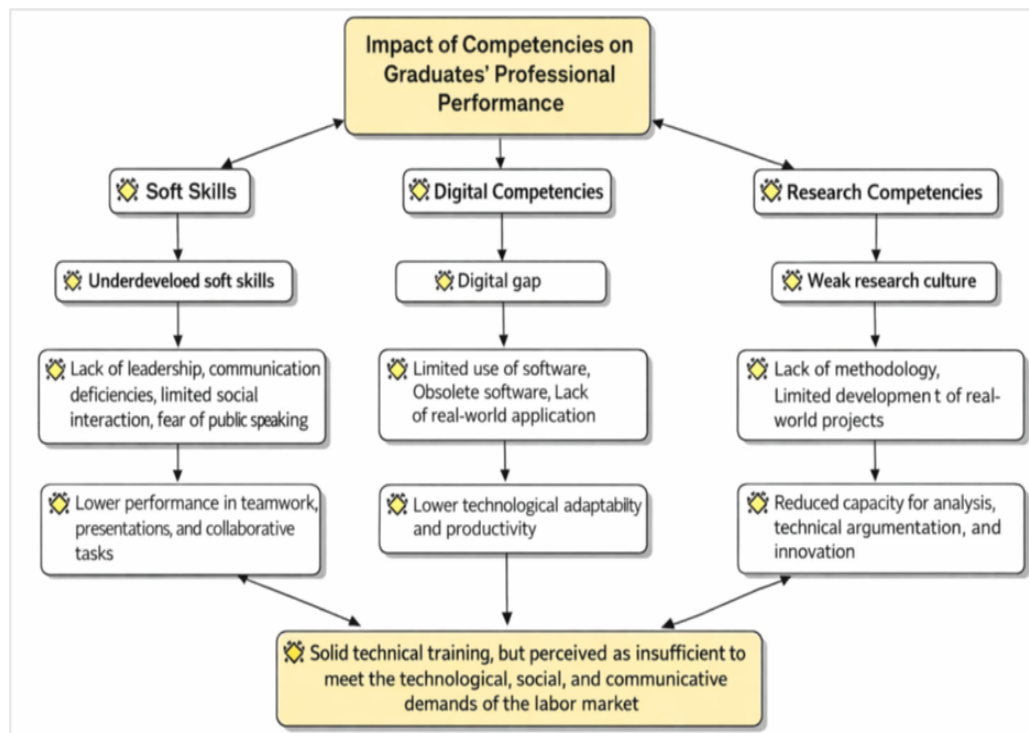
technological advances. In practice, this forced many graduates to learn independently or outside of university before graduating. This digital gap affected the speed of adaptation and reduced the competitiveness of graduates when entering the job market.

On the other hand, research skills were one of the most notable weaknesses. Although some

graduates acknowledged having acquired theoretical foundations, most felt that there was a lack of clear research methodology, real opportunities to participate in projects, and specialized teaching support during their university education. Research has been perceived as an optional process, with little guidance and distant from industry, which has limited the capacity for in-depth analysis, technical argumentation, and innovative problem-solving in the professional environment.

When these aspects are integrated, it can be seen that the three areas of competence are related to broader perceptions of the relevance of training, curriculum updates, and the connection between theory and practice. Graduates emphasized that, although the university provided a solid foundation in critical thinking and logical reasoning, there has been a perceived gap between academic training and current market demands. The absence of up-to-date laboratories, limited links with companies, lack of practical workshops, and insufficient training in soft skills reinforce this sense of disconnect.

Job performance does not depend solely on technical training, but on a balanced combination of interpersonal, digital, and research skills. When these areas are insufficiently developed, graduates perceive their transition to the job market as more complex and requiring additional self-training. Consequently, graduates recommend more comprehensive, practical, and up-to-date training that is better able to respond to the technological and social challenges of the professional world.



Meta-inferences from the study: integration of quantitative and qualitative results

The quantitative and qualitative results show, in a convergent manner, that the job performance of graduates depends both on their technical foundation and on the actual level of development of their soft, digital, and research skills. Although the training received at university has provided a solid foundation in critical thinking, logical reasoning, and problem-solving, gaps in cross-cutting skills limit professionals' ability to fully respond to the demands of today's work environment.

Transformation

The findings indicate that research skills have the greatest predictive weight in the probability of achieving higher levels of performance. This evidence is complemented by qualitative accounts, in which numerous graduates point out that research played a marginal role in their training, with little teaching guidance, few real projects, and limited emphasis on the use of up-to-date methods and tools. The convergence between both sources suggests that the lack of a solid research culture affects the ability to analyze, argue technically, and work independently.

In the case of soft skills, quantitative results showed that low levels significantly decrease the probability of achieving high performance. This trend coincides with the testimonies, which describe training focused on hard skills and highly theoretical courses, with few opportunities to develop communication, leadership, oral presentation, emotion management, and collaborative work skills. These limitations explain the widespread perception of insecurity when presenting ideas, difficulty in leading teams, and barriers to functioning in multidisciplinary environments.

With regard to digital skills, although their impact is less significant compared to the other two dimensions, quantitative and qualitative evidence agree that the training offered is insufficient and out of step with the market. Graduates said they learned essential software on their own and that many of the courses included obsolete tools or tools that were not closely related to real-world industry tasks. This affected their technological adaptability and limited the speed with which they could integrate into more advanced work environments.

Expansion

Triangulation showed that training satisfaction and job relevance are not external variables, but dimensions that broaden the understanding of professional performance. Most graduates said they were satisfied with the training they received, although this satisfaction decreases when evaluating the connection between training and current market demands. Graduates valued academic rigor and technical rigor, but acknowledged that practical training, the use of up-to-date software, laboratories, technical visits, and soft skills workshops were insufficient. This gap explains, to some extent, the difficulty of quickly integrating into positions that require modern tools, social skills, and technological mastery.

Similarly, the qualitative results indicate that graduates feel they should have strengthened key skills such as communication, leadership, public speaking, teamwork, creative thinking, and emotional management on their own. These weaknesses are directly related to low self-assessed performance in areas where social interaction, team management, and strategic communication are decisive.

Convergence

The integration of the findings has confirmed that the three competencies analyzed converge on a central point: university education offers a solid foundation, but one that is not fully aligned with the technological and social demands of the contemporary labor market. University graduates have a highly valued analytical and technical profile, but face limitations in quickly adapting to environments that require soft skills, digital proficiency, and applied research capabilities.

Taken together, the meta-inferences show that high job performance is achieved when the three competencies are developed in a balanced manner; that job relevance and educational satisfaction function as indirect indicators of the level of competencies developed; and that the main gap in the educational model is the disconnect between theory and its practical application, especially in soft skills, job-related software, and guided research activities.

4] Discussion

The results of the study show a clear consistency between the quantitative patterns observed and the perceptions expressed by graduates, which allows for a more accurate understanding of how soft, digital, and research skills influence job performance. The discussion is organized around three axes: the relationship between skills and performance, the relevance of university education, and the implications for curriculum improvement.

The first relevant finding is that research skills are the strongest predictor of high job performance. This result coincides with the literature, which points out that the ability to analyze complex problems, justify decisions, and sustain solid arguments is central to contemporary engineering work. As Tobón and other authors argue, research is not exclusively an academic activity, but a way of thinking that supports continuous improvement, innovation, and decision-making in real contexts. Qualitative evidence supports this trend: many graduates acknowledge that research was only present in a fragmented or poorly guided way at university, forcing them to develop this skill independently once they entered the job market. The lack of sustained research experience, consolidated mentoring, and real projects seems to limit the technical autonomy that the current market demands.

A second relevant finding is the role of soft skills. Although their statistical effect is less than that of research skills, it is still highly significant: those who report low levels of soft skills are much less likely to achieve high levels of performance. This pattern is consistent with research highlighting that communication, collaboration, leadership, and emotional management have become central elements for employability. Qualitative evidence reinforces this interpretation: graduates mention difficulties in presenting, insecurity when speaking in public, little leadership experience, and limited practice in collaborative work. This gap is in line with studies indicating that engineering programs, especially in public institutions, tend to maintain curricular structures focused on technical content, relegating social skills to marginal or extracurricular spaces.

Third, digital skills show a significant, albeit moderate, effect on performance prediction. The international literature highlights that digital transformation requires engineers to use specialized software, data analysis tools, and technology platforms. However, the accounts reveal that many graduates learned these tools on their own or on the job. The use of obsolete software and lack of practice with current tools explain why, despite the fact that digital competence contributes to performance, its impact is not as strong as might be expected in a digitized work context. This finding is consistent with recent studies that show significant digital gaps in Latin American universities.

The discussion also shows that job relevance and educational satisfaction serve as indirect indicators of the level of skills acquired. Although most graduates say they are satisfied with their education, this satisfaction decreases when assessing the connection between the content and the actual demands of the job. Participants highlight academic rigor and a solid theoretical foundation as strengths, but agree that practical training, the use of up-to-date software, technical visits, and links with companies were insufficient. The literature shows that this disconnect between theory and practice is one of the most persistent challenges in engineering education, especially in public institutions where resources for laboratories and equipment are often limited.

Qualitative accounts indicate that this disconnect forced many graduates to complete the practical and technological learning necessary to enter the market on their own. This suggests a tension between the traditional training model—highly theoretical and focused on rigid courses—and the current need to train flexible, collaborative, and technologically competent professionals. The gap between expectations and reality is also evident in the recurring recommendation of graduates: update curricula, modernize laboratories, strengthen soft skills, and open spaces for contact with industry.

The integration of quantitative and qualitative results allows us to understand that high job performance does not depend solely on technical mastery, but on a balanced combination of research, soft, and digital skills. The three

competencies operate as an integrated system. Strength in critical thinking and logical reasoning—a highly valued characteristic of university education—serves as a foundation, but is limited when not accompanied by communication skills, technological mastery, and up-to-date methods of analysis.

Furthermore, the findings suggest that research, soft, and digital skills are not isolated elements, but components that reinforce professional autonomy. The evidence indicates that graduates with greater research skills also tend to show better abilities to communicate results, lead projects, integrate teams, and adapt to changing technological environments. This coincides with international studies that consider these competencies as an integrated set that supports long-term employability.

The results of the study highlight the need to rethink traditional engineering education models, shifting them toward more integrated and contextualized curricular approaches. Within this framework, it is essential to strengthen research training through active methodologies and real-world projects, incorporate digital technologies and up-to-date software into specialized courses, and systematically develop soft skills that can be applied in professional settings. It is also key to promote sustained links with the business sector and update curricula in line with technological trends and the career paths of graduates. In this sense, university education must transcend technical mastery and focus on developing professionals capable of adapting, communicating, researching, and leading in contexts of continuous innovation.

5] Conclusion

The study provided a comprehensive understanding of how soft, digital, and research skills influence the job performance of engineering graduates trained at a Peruvian public university. Based on the triangulation of quantitative and qualitative analyses, it is concluded that job performance depends on an integrated set of cross-cutting skills. In particular, research, soft, and digital skills act in a coordinated manner and are decisive in explaining higher levels of professional performance, as they

enhance graduates' ability to tackle complex tasks, adapt to changing environments, and communicate effectively in multidisciplinary teams.

The results of the ordinal logistic regression model show that research skills are the strongest predictor of job performance, with the highest coefficients and statistically significant associations. Graduates with lower research skills are considerably less likely to achieve high levels of performance, confirming the importance of analytical skills, technical reasoning, and the generation of solutions based on professional engineering practice.

Likewise, it was identified that soft skills continue to be a critical gap in professional training. Although some graduates report high levels in these competencies, low levels are clearly associated with lower probabilities of high performance. Qualitative findings reveal persistent weaknesses in leadership, communication, collaborative work, and oral expression, which negatively impact job placement, project development, and team management.

On the other hand, digital skills show a significant, albeit moderate, impact compared to research and soft skills. However, most graduates indicate that learning about up-to-date software and digital tools took place outside the university, highlighting an institutional gap associated with the use of obsolete technologies and limited course updates, a situation that limits preparation for increasingly automated and data-driven labor markets.

In this context, job relevance and educational satisfaction emerge as indirect indicators of the level of skills developed. Although graduates value the academic rigor and technical training

they received, they express concern about the weak link between the university and the labor market, especially in terms of professional internships, use of technologies, infrastructure, and soft skills development.

Finally, the main gap in the educational model relates to the disconnect between theory and its practical application. The evidence suggests the need for a curriculum redesign aimed at developing integrated skills through authentic practices, interdisciplinary projects, applied research experiences, and greater links with the productive sector. This process must be accompanied by teacher training, improvement of technological infrastructure, and the strengthening of sustainable partnerships with companies, in order to reduce the gap between university education and the demands of the professional environment.

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8] Data Availability:

The data supporting the findings of this study are available in SPSS .sav and Excel .xlsx file formats.

9] Conflict of interest:

The authors declare that there is no conflict of interest.

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