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PAPER

Undergraduate Research Training and Generic Competencies in Engineering Graduates

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ABSTRACT

Higher education programs are embracing curricular models that incorporate active teaching-learning methodologies to foster students' active participation in knowledge building, based on competency-based training. Research-based learning (RBL) stands out as an active methodology that can be used at various academic levels, including undergraduate. In this context, the present research explores the contribution of undergraduate research training to the process of developing generic competencies in engineering students. The study focuses on the perceptions of a group of employers and graduates from a Peruvian higher education institution. A mixed-methods approach was adopted, as interviews and surveys were applied. The study had a descriptive purpose with a concurrent design. The findings suggest that undergraduate research training is perceived as supporting the development of generic competencies such as research, teamwork, effective communication, analytical and critical thinking, adaptability, digital literacy, intellectual curiosity, and lifelong learning (LL). Overall, the results highlight undergraduate research training, implemented through RBL, as an effective strategy associated with the development and strengthening of generic competencies and the alignment of Science, Technology, Engineering, and Mathematics (STEM) education with labor market demands, while underscoring the importance of consolidating an institutional research culture within competency-based curricula.

KEYWORDS

undergraduate research training, generic competencies, research-based learning (RLB), engineering education, science, technology, engineering, and mathematics (STEM)

1 INTRODUCTION

Over the last 100 years, educational trends have been leaning towards the use of active methodologies for the teaching-learning process [1, 2]. These are based on students having a leading role within the training process [3, 4, 5], as they encourage their participation towards the construction of knowledge [6]. In doing so, they promote the development and reinforcement of meta-learning, a necessary competency for

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self-regulation [7], which is also needed to guarantee lifelong learning (LL) [8]. Active methodologies include project-based learning (PrBL) [9], problem-based learning (PBL) [10], team-based learning (TBL) [11], and research-based learning (RBL) [12].

Among the above, RBL, also identified as inquiry-based learning, stands out for its relationship with the development of generic competencies [13]. In fact, it is grounded in the "knowing how to know" and "knowing how to do," which represent two of the four (4) foundational attributes of competencies [8]. RBL has two fundamental properties: (1) it is research-directed and guided by a professor as part of the teaching role, and (2) the research agents are not research professionals but rather subjects in training [14]. RBL requires students to carry out activities such as conducting observations, proposing questions, examining literature, planning research, developing and applying tools to collect data, analyzing and interpreting information, suggesting solutions, and communicating results [8, 15, 16, 17].

In this context, RBL has been reported to bring several benefits for students, as it improves their knowledge, interest in learning, self-engagement [18], and creativity [19]. At the same time, it fosters the learning of all the stages of the research while developing critical thinking, promoting questioning styles of thinking, and making LL a core value [20]. As RBL focuses on engaging students in practical activities to investigate scientific phenomena [21], it is a methodology that indeed allows them to construct their own knowledge [22, 23]. Consequently, RBL can be used for research at various academic levels, including undergraduate.

Within the higher education context, RBL is used for undergraduate research training. Undergraduate research may be defined as research carried out by an undergraduate student, who aims to make an original intellectual or creative contribution to his or her discipline [13]. It is a collaborative activity in which the student, with the guidance of a teacher, develops all the phases of an investigation. Consequently, skills such as creative and critical thinking, effective communication, and the asking "what if" and "why not" questions are put into practice [24]. Within the Science, Technology, Engineering, and Mathematics (STEM) field, this last skill is particularly important, as students are required to test their ideas in a systematic and interactive way [25]. Thus, undergraduate research training has been integrated through diverse research experiences across engineering curricula [5, 8, 26, 27, 28].

In a parallel scenario, higher education programs are committed to competency-based curricular models. In fact, at the "World Conference on Higher Education 2022" (CMES), integral training based on competencies was reaffirmed as an axis for higher education [29]. Competencies may be understood as a set of skills, attitudes, and values that are required for the holistic development of the learners [30]. Competency-based curricular models, grounded in the development of competencies, equip students to adapt effectively to ongoing environmental changes, while constructing knowledge across diverse contexts. In fact, a competency-based curriculum emphasizes the development of both specific competencies, that are particular to each discipline, and generic or transversal competencies, that are shared across professional fields [31]. Across the literature, specific competencies may also be identified as hard skills, while generic competencies are acknowledged as soft skills [32]. Generic competencies are also referred to by a variety of terms, such as key competencies [33], transferable skills [34], professional skills [35], non-technical skills [36], employability skills [37], and twenty-first-century skills [16].

Generic competencies are nourished by knowledge from all academic areas and use the contributions of daily experiences and the challenges of the environment, allowing a knowledge-based societal perspective [38]. Furthermore, they actively contribute to the achievement of the 17 Sustainable Development Goals (SDGs), since they imply adapting to technological advances and collaborating internationally [39]. Certainly, they support students in keeping their knowledge current by fostering LL [8] while contributing to the effective acquisition, development, and consolidation of hard skills [40]. Effective communication, teamwork, leadership, adaptability, critical thinking, or emotional intelligence may be considered as examples of generic competencies [41, 32, 42, 43]. Along these lines, educational stakeholders and accreditation boards worldwide emphasize the importance of addressing these competencies throughout the curriculum, as they provide better employment opportunities and mobility possibilities between different job positions [30].

To date, the literature highlights the benefits of undergraduate research training for developing specific competencies [44, 45], shaping professional aspirations [46, 47], strengthening an institutional research culture [48], fostering employability outcomes [48, 28], and promoting the acquisition of disciplinary research skills [26, 27]. However, there is a lack of specific evidence specifically linking how undergraduate research training contributes to the development of generic competencies in STEM education.

To address this gap, the present case study examines the relationship between undergraduate research training and the development of generic competencies within three undergraduate engineering programs at a private Peruvian university: Industrial, Civil, and Systems. In doing so, it explores employers' and graduates' perceptions regarding how such undergraduate research training contributes to the acquisition and reinforcement of generic competencies. For the purposes of this study, the research question was formulated as follows: how is the contribution of undergraduate research training to the process of developing generic competencies in engineering graduates in Lima, Peru? Additionally, to ensure a narrower scope of this study, two specific objectives of this study were defined: (1) identify the generic competencies most valued by employers of engineering graduates and those missing from the graduate profile, and (2) describe the perception of levels of knowledge in research among engineering graduates.

2 LITERATURE REVIEW

2.1 Research culture

Regularly, undergraduate research training is exercised within a research culture, or culture of research framework, as undergraduate research training is a fundamental pillar for reducing the gap between scientific productivity and the challenges of the industry [49]. To date, "research culture" is a term that does not have a single definition throughout the literature [50], even though most authors suggest the idea of having a particular research environment. In fact, they hold different perspectives.

An often-accepted meaning is the one provided by [51], who stated that research culture refers to an environment characterized by interpersonal support and collaboration, in which colleagues share an affinity for the value of research [51] and uphold behaviors, values, expectations, attitudes, and norms associated with scholarly activity [52]. In addition, [53] proposes that research culture shapes and regulates aspects of the scientific process. These aspects go from how research is conducted in the laboratory to how discoveries are communicated to the public. Other authors such as [54], [55], [56], [57], [58], and [59] support this definition too.

Furthermore, [60], [61], and [62] state that research culture is an enabling environment that encourages better research outputs. [63] and [64] indicate that research culture requires a constant interaction between humans, curricula, and the normative within the university environment. When characterizing research culture, [65] argues that it includes each individual's capacity to exercise research activities, which can be built, enhanced, and refined through proper training. As for this study, research culture may be understood as a dynamic academic environment, where shared values, norms and institutional practices (1) support undergraduate research training; (2) strengthen individual and collective research capacities; and (3) facilitate the integration of research into curricula, professional practice and societal and industry-related challenges.

2.2 Undergraduate research training

Undergraduate research training encompasses both the production of research outcomes and a student-centered approach. This approach fosters the development of skills such as a deeper understanding of discipline-specific concepts and the construction of new knowledge based on existing information [13, 14]. According to [66], it may be defined as: "an inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline." Undergraduate research training requires the support of a professor as a guide to develop all the phases of the research process, according to the student's discipline [24].

Undergraduate research training uses research as an active method in the teaching-learning process. It is supported by RBL, an active methodology where students take the leading role in the research process. In RBL, the instructor assumes a facilitator role, while students autonomously carry out research tasks [67, cited by 68]. Through a series of activities that they must carry out, such as asking questions, examining sources of information, and proposing solutions, students become active participants in their own learning [69]. While conducting these activities, competencies such as critical and creative thinking, oral and written communication, and the habit of asking "what if" and "why not" questions are put into practice [24]. Thus, undergraduate research training may benefit students on personal, professional, and intellectual levels [70].

For this reason, undergraduate research training has been integrated through diverse research experiences embedded across STEM education [5, 8, 13, 26, 27]. There are various strategies to integrate these experiences throughout the curricula: workshops, honor programs, faculty research projects, tutoring by professors in independent studies [71], and student organizations [72]. Another strategy is course-based undergraduate research experiences, which are curriculum-based research opportunities [43].

Undergraduate research training in STEM education not only promotes the development of discipline-specific and research-related competencies but also contributes to the strengthening of generic and employability-related competencies, including effective communication, teamwork, and leadership [8, 44, 45]. It also provides a structured framework through which students address real-world problems related to professional practice, thereby strengthening analytical thinking and intellectual curiosity, which are considered fundamental pillars within STEM fields. Additionally, it promotes autonomy and self-discipline, enhancing students' ability to acquire new knowledge. Consequently, it fosters LL, which is essential for keeping professionals up to date throughout their careers [13].

2.3 Generic competencies

Generic competencies constitute a core component of competency-based STEM education, as they integrate knowledge, skills, and values that are transferable across disciplines and professional contexts [73]. Unlike specific competencies, which are directly related to discipline-specific and technical expertise, generic competencies address transversal aspects of professional performance, enabling professionals to adapt to diverse and changing environments [8, 74].

Effective communication, teamwork, leadership, ethical and professional responsibility, structured work planning, meta-learning, and LL are among the generic competencies commonly fostered in STEM education [41]. Because these competencies are applicable across different stages of professional life, they are considered to be more enduring than specific competencies and serve to complement disciplinary knowledge [74]. Given the need to enhance graduates' employability and align academic training with labor market expectations, the development of generic competencies has become especially pertinent [30].

As highlighted by [13], generic competencies are among the most valued by organizations, as they facilitate professional integration, adaptability to change, and LL. Employers increasingly demand engineers who can communicate effectively, collaborate in multidisciplinary teams, and apply knowledge ethically and responsibly in real-world contexts. Consequently, STEM programs are required to implement active and student-centered methodologies that promote the systematic development of these competencies throughout the curriculum.

However, despite their relevance, the development of generic competencies in higher education continues to face unresolved challenges associated with institutional and curricular support. These challenges include pedagogical approaches, assessment practices, and the perceptions of both teachers and students [75]. In this context, [76] identified conditions that may enhance their development: interactive teaching focused on conceptual understanding, collaborative learning processes, ongoing feedback and tutoring, and flexible assessment methods. Accordingly, the development of generic competencies is fostered through the integration of active learning methodologies [75], such as PrBL, PBL, TBL, and RBL [77].

Thus, undergraduate research training has been identified as a key pedagogical strategy for fostering generic competencies in STEM education. Previous studies in STEM education have emphasized the contribution of undergraduate research to disciplinary research skills and employability outcomes [26, 27]. Furthermore, [13] explicitly demonstrated how undergraduate research training contributes to the development and reinforcement of generic competencies specifically within a civil engineering program. The findings show that RBL, applied through undergraduate research training, functions as a formative bridge between academic training and professional practice, promoting effective communication, teamwork, ethical awareness, and meta-learning. Moreover, this approach not only strengthens students' research skills but also enhances their employability, adaptability, and LL disposition, responding effectively to the demands of the STEM field.

In conclusion, within competency-based education, active learning methodologies play a central role in fostering the development of generic competencies. In this context, RBL provides students with opportunities to engage in undergraduate research experiences that promote research skills, communication, analytical thinking, and problem-solving. These experiences are supported by an institutional research culture that encourages active participation in knowledge construction. Consequently, undergraduate research training implemented through RBL can be conceptually associated with the perceived development of generic competencies relevant to engineering education and professional practice. The theoretical model linking these concepts is shown in Figure 1.

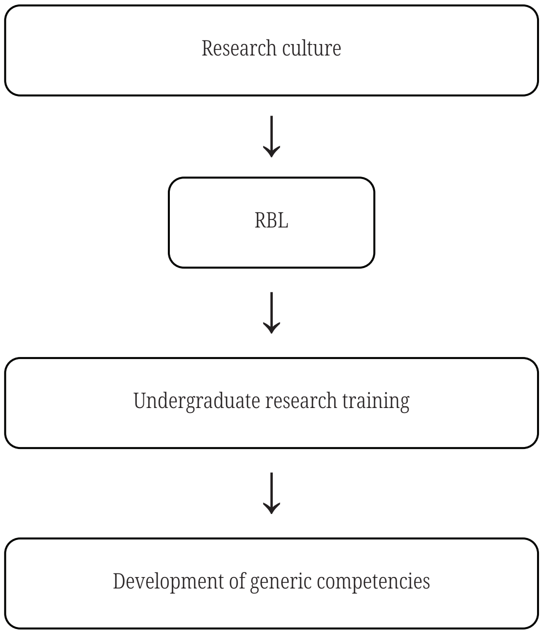

Fig. 1. Theoretical model: RBL, undergraduate research training, research culture, and generic competencies

3 MATERIALS AND METHODS

3.1 Design and participants

The research followed a mixed approach [49]. The study adopted a concurrent design in which qualitative and quantitative data were collected during the same stage of the research process and analyzed in parallel. Integration between both strands occurred during the interpretation and discussion phases through methodological triangulation, allowing the comparison and complementarity of employers' perceptions and graduates' self-perceptions regarding the contribution of undergraduate research training to the development of generic competencies [78].

In this sense, qualitative findings provided contextual and interpretative insights into the competencies valued within professional practice, while quantitative findings contributed descriptive evidence regarding graduates' self-perceived research knowledge across cognitive, investigative, methodological, and collaborative dimensions. The integration of both datasets enabled a broader understanding of the research phenomenon and strengthened the interpretation of the findings.

The study had a descriptive purpose, since the objective was to characterize the contribution of undergraduate research training to the process of developing generic competencies in engineering graduates in Lima, Peru [49].

The participants of this study included two different educational stakeholders from Civil, Industrial and System engineering programs at a Peruvian higher education institution: employers and graduates. In the case of employers, senior professionals representing national companies in the engineering field were considered. As for graduates, professionals with a maximum of two years of graduation, who are currently employed, were included.

Thus, the resultant sample included ten (10) informants for the interviews, according to what is suggested by the literature, as recommendations for qualitative research emphasize the depth of the data collected rather than statistical representativeness. Consequently, nonprobability sampling was applied, specifically judgment sampling, since the researchers deliberately selected the participants based on the characteristics of the target population and the technical criteria previously described [79]. Table 1 presents a detailed overview of the sample's characteristics.

Table 1. Employers' sample characteristics by industry

Industry	Sample
Architecture	1
Industrial Engineering	5
Civil Engineering	4
Total	**10**

However, regarding the survey, the sample size was calculated to ensure the representativeness of the target population, which is predominantly composed of Industrial Engineering graduates. Consequently, the higher proportion of participants from this discipline reflects the actual distribution of graduates within the institution rather than a sampling imbalance. Stratified probabilistic sampling was used, according to the professional careers included in the study, ensuring a 95% confidence level [78]. A total of 140 surveys were obtained. From the total sample, 57.14% of surveyed graduates belong to the 2021–2025 cohorts, whereas 42.86% graduated in 2020 or earlier. Table 2 presents a detailed overview of the sample characteristics.

Table 2. Graduates' sample characteristics by industry

Industry	Sample
Industrial Engineering	113
Systems Engineering	19
Civil Engineering	8
Total	**140**

3.2 Data collection

Data were collected through two different techniques, according to the mixed approach: interviews and a survey.

Exhaustive interviews were applied to employers, with the purpose of identifying the generic competencies most valued in engineering graduates. Those competencies that still needed to be developed and/or reinforced were also identified. A semi-structured guide was developed, with the aim of having the freedom to introduce additional questions to delve into issues that arose throughout the interview. The guide included four sections: (I) introduction, (II) demographic information, (III) applied questions, and (IV) closure. Table 3 presents the eight questions that addressed the requirements of the industry, which correspond to section III.

Table 3. Questions for the interview guide for employers

No	Questions Asked
1	According to your experience, what are the requirements of your sector? And what are the training requirements that you would demand from professionals at the university level?
2	What is your opinion about the preparation of educational institutions at university level to respond to the requirements of their sector?
3	What gaps do you see in university education according to the requirements of your sector?
4	What are the generic competencies (soft skills) most valued by your sector for graduates? And the specific ones (hard skills)? Why?
5	Of the following generic competencies: leadership, collaborative work, proactivity and autonomy, positive attitude towards innovation and entrepreneurship, analytical skills, oral communication, writing, ethical behavior and commitment to sustainable development, which do you think are, in ascending order, the most valued by the market?
6	What generic competencies (soft skills) do you think graduates still need to develop? And which ones to strengthen?
7	Have you heard about “undergraduate research training”? What notions do you have about it? What is your opinion on this? Is it relevant to professional performance?
8	During your academic training, did you receive training in research? What was its scope? What impact did it have on your professional performance?

A survey was also conducted among the graduates. This allowed for describing the self-perceived levels of research knowledge among engineering graduates. For the construction of the survey, the Scopus database was revised to identify existing validated questionnaires measuring self-perceived levels of research knowledge [80, 81, 82, 83].

Survey questions from the selected instruments were organized into dimensions following the framework proposed by [84]: cognitive, investigative, methodological, and collaborative. Following common practice in research, the items were reviewed, selected, and adapted to measure the study variables within the specific context of the present research [78]. The questionnaire subsequently underwent expert validation procedures to ensure both methodological rigor and content validity.

As a result, a questionnaire of 29 closed questions was obtained, using a 5-point Likert scale whose values went from 1, ‘strongly disagree,’ to 5, ‘strongly agree.’ The questionnaire was organized into four sections, corresponding to the dimensions: (I) cognitive, (II) investigative, (III) methodological, and (IV) collaborative. Section (I) contained six items; section (II), five; section (III), 12; and section (IV), six, as shown in Table 4.

Table 4. Questionnaire on undergraduate research training for graduates

Dimension	Statements
Cognitive skills	I identify the relevant problems in my environment for the development of research.
	I value the textual and non-textual information that I find in databases such as Scopus, Scielo, among others.
	I organize the information found by topics, levels, or categories based on the identification of differences and similarities of a research topic.
	I verify that the writing of my research is clear and precise in order to communicate it.
	I support my arguments with quotes from relevant authors, data, and facts to ensure their validity.
	I relate the different components of the research (title, problem, question, objectives, methodology, results, and conclusion) so that there is coherence between them.
Investigative skills	I use concepts and keywords to search for information in reliable sources.
	I look for information in databases to build research (Scopus, Redalyc, Latindex, Scielo, and Google Scholar).
	I use bibliographic managers to organize information (Mendeley, Zotero, Endnote, and Refworks).
	I use ICT and AI to organize information (Dropbox, Pocket, OneDrive, ICloud, and ChatGPT).
	I use social networks to communicate research results (Linkedin, Google and Scholar).
Methodological skills	I categorize bibliographic sources relevant to the topic to identify possible research challenges.
	I identify a research challenge with the guidance of the professor to autonomously increase my specific knowledge about the profession.
	I formulate the problem statement and the research question, relating them to the context to demonstrate a critical position on the topic.
	I define the scope of the research according to the level required for the topic to establish a detailed work plan.
	I formulate research objectives in a precise, clear, and achievable way to answer the research question.
	I consolidate a review of the state of the art on the subject of study to contextualize the key points of the research.
	I select the relevant theories and theoretical foundations to build a theoretical framework that supports the hypothesis of my research.
	I formulate the hypothesis about the research topic to contrast the statement of the problem and the results obtained.
	I interpret the results objectively to establish relationships between new knowledge and pre-existing knowledge.
	I develop conclusions to evaluate the processes developed and the results obtained from the bibliographic review.
	I suggest recommendations based on the results obtained to support the implementation of improvement.
	I write documents with scientific-technical rigor to disseminate the results of the research following a citation style (APA, Harvard, Chicago).
Collaborative skills	I use digital tools to communicate and coordinate with the members of the research team (WhatsApp, forums, Facebook, Skype, Hangouts, and email).
	I use virtual platforms to share, analyze, discuss, and build knowledge (Google Drive, Dropbox, and OneDrive).
	I participate in the planning of the work, the distribution of tasks, and the setting of deadlines to ensure the efficient fulfillment of the objectives of the research.
	I assume the fulfillment of the assigned tasks and collaborate with the members of the research team when they have difficulties to allow for the correct progress of the research.
	I recognize the potential of all team members for task assignment.
	I consider the points of view of others and make constructive criticism to ensure optimal fulfillment of research objectives.

Both research instruments were reviewed and approved by the *Comité de Integridad y Ética en la Investigación de la Facultad de Ingeniería* from Universidad de Lima. Participants' prior informed consent was also obtained before application. All results were securely stored in files accessible only to the research team.

3.3 Data analysis

In a first instance, data analysis employed a thematic analysis approach [85]. The qualitative data from the interviews was transcribed verbatim and coded line by line to include relevant quotes from every participant. This process yielded an initial set of codes that were subsequently reviewed and refined using ATLAS.ti software [86].

These obtained codes were reviewed manually and grouped into categories: families that share common characteristics. Finally, categories were associated with themes [87]. Since the approach of this study prioritizes interpretation and contextual understanding of competencies, codes were organized according to eight of them: (1) teamwork, (2) effective communication, (3) research, (4) LL, (5) intellectual curiosity, (6) adaptability, (7) analytical and critical thinking, and (8) digital literacy. Figures 2 to 5 illustrate this process, which includes the coding structure, emerging codes, categories, and themes.

In a second instance, for the quantitative data, information coding was used. Data was manually entered and coded for processing using Microsoft Excel, as suggested by the literature [78]. The Likert-scale items were analyzed through descriptive statistics to identify patterns and central tendencies. Values of 5 and 4 were interpreted as levels of agreement, whereas values of 1 and 2 indicated levels of disagreement.

4 RESULTS

The following section presents the findings from the applied data collection techniques: interview and survey. Thus, it is organized into two (2) subsections to address each method in turn.

4.1 Interview

In the first phase of data collection, employers were interviewed to identify the generic competencies most valued in engineering graduates, as well as perceived gaps in their development during professional training. Since the focus was competencies, this subsection is organized according to the categories and themes around them. The identified competencies were research, LL, critical and analytical thinking, effective communication, teamwork, intellectual curiosity, adaptability, and digital literacy. As employers represent a principal stakeholder within the educational context, this perspective enabled the identification of the need to strengthen coordination between university and industry.

Research competency was addressed by employers who considered that undergraduate research experiences are fundamental for its development. They identified several related categories for this theme, as shown in Figure 2: impact of professional research, research-oriented thinking, and research capacity.

Regarding the first category, impact of professional research, employers acknowledged that research training may have a positive impact on the professional field, as research promotes an analytical way of thinking. They recognized this is the reason why research is needed, not only at a doctoral or master level, but also on companies. As for the second category, research-oriented thinking, employers stated that research experiences promote students asking questions about their surroundings. Moreover, they support learning about different topics, fostering creativity. Finally, about the third category, research capacity, employers highlighted the methodological approach to thinking that it promotes, encouraging individuals to explore multiple solutions to the same problem:

> *"[Research training impacted my professional performance because I always perform] product analysis in marketing."*

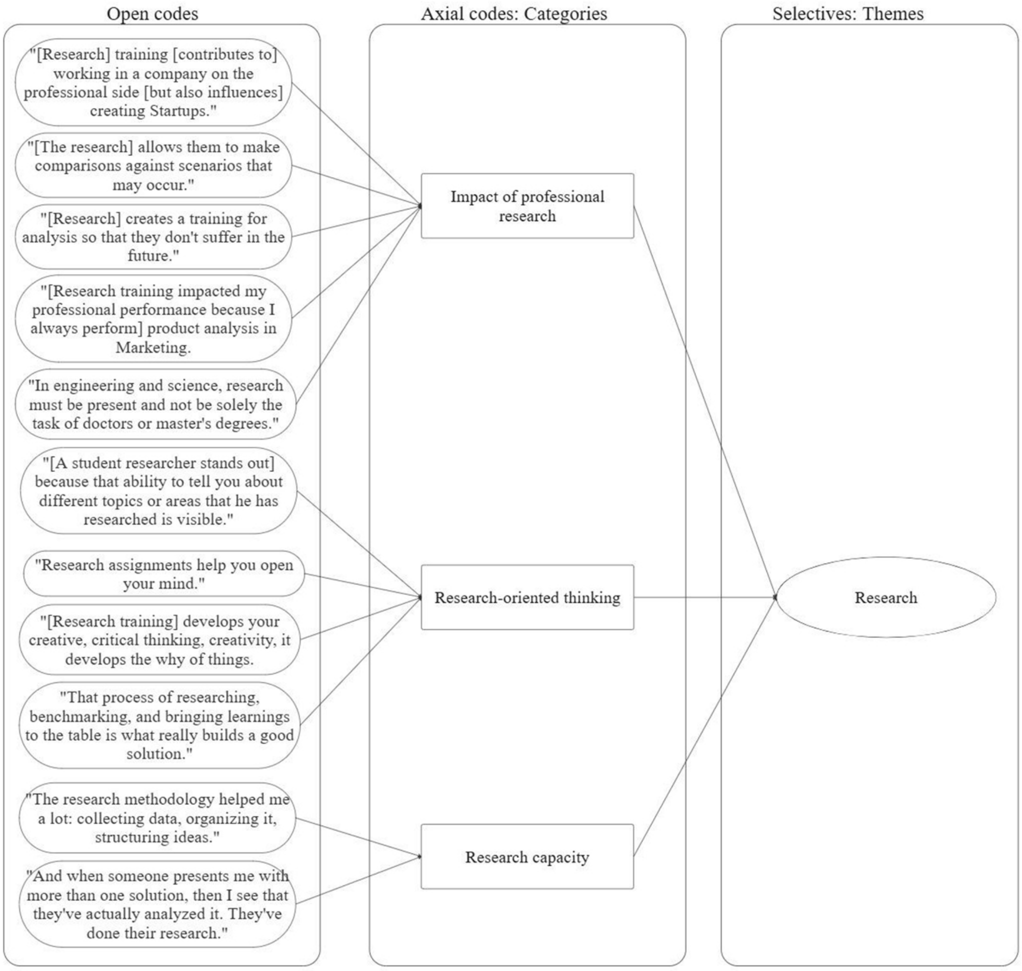

Fig. 2. Codes, categories, and themes identified for the research competency

Lifelong learning was also discussed. Employers considered that implementing undergraduate research experiences has significant relevance for the development of this competency. Commitment, continuous improvement, and ongoing training were some of the identified categories for this theme, as presented in Figure 3. While commitment associates LL with the idea of generating value to organizations, continuous improvement is associated with quality, as stated:

> *"…it's not enough to have your position, it's your ability to generate value…"*
> *"I always tell my team we're about quality, and quality is continuous improvement."*

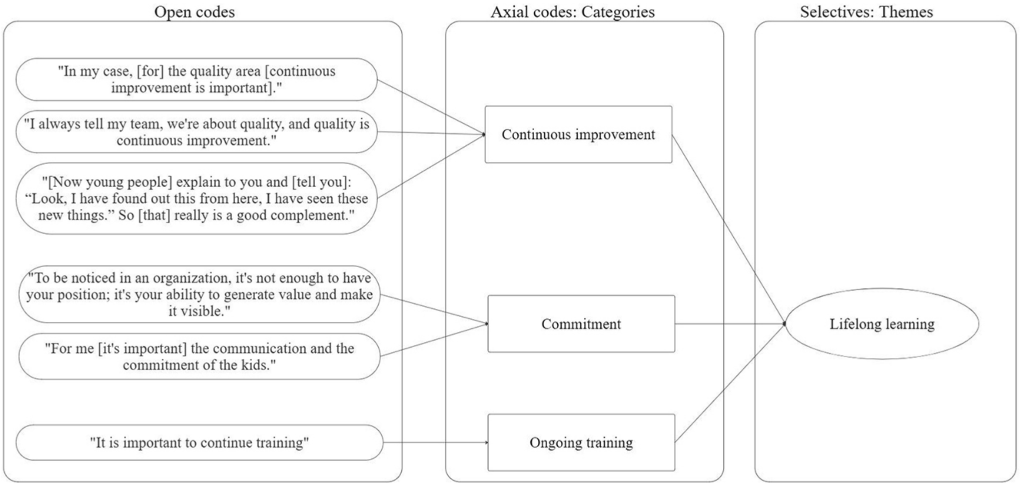

Fig. 3. Codes, categories, and themes identified for the LL competency

Analytical and critical thinking was also addressed by employers who considered that implementing undergraduate research experiences may also positively impact the development of this competency. Categories identified for this theme included strategic, analytical, critical, structured, and cross-cutting analytical thinking. These are shown in Figure 4.

Regarding strategic thinking, employers recognized that this competency is closely related to research practices as they lead the student to formulate questions and hypotheses about a determined subject. In the case of analytical thinking, employers highlighted its importance in the decision-making process, particularly for both deductive and inductive analysis. They believed that young people possess a strong capacity for analysis when using new technologies; however, they require a better understanding of the scientific method to produce accurate reports and reliable indicators. This is stated as follows:

> *"This sector's requirement is to include a strong critical and analytical approach to producing reports and indicators to be implemented."*

In relation to critical thinking, employers recognized the relevance to formulate individual conceptions of what is learned to really understand a subject. It was stated that this competency would be valuable to produce reports and indicators to differentiate correlation from causality.

> *"Many people only describe without truly understanding what they're analyzing. A critical skill is knowing how to differentiate correlation from causation."*

For structured thinking, employers argued that while being asked to solve a problem as a manager, it is key to correctly structure thoughts and generate a coherent line of ideas. This is also important when evaluating somebody else's answer to a problem. Finally, in respect to cross-cutting analytical thinking, the professionals highlighted its relationship with analytical skills, which allows candidates to reason instead of just applying the theory they were taught. It is believed this training allows active learning where individuals are able to construct answers that are rarely given in real-world scenarios.

"That kind of training [through analytical thinking] – where you're taught to reason instead of just applying it – is what really translates into the real world, where answers are rarely given, and you almost always have to construct them."

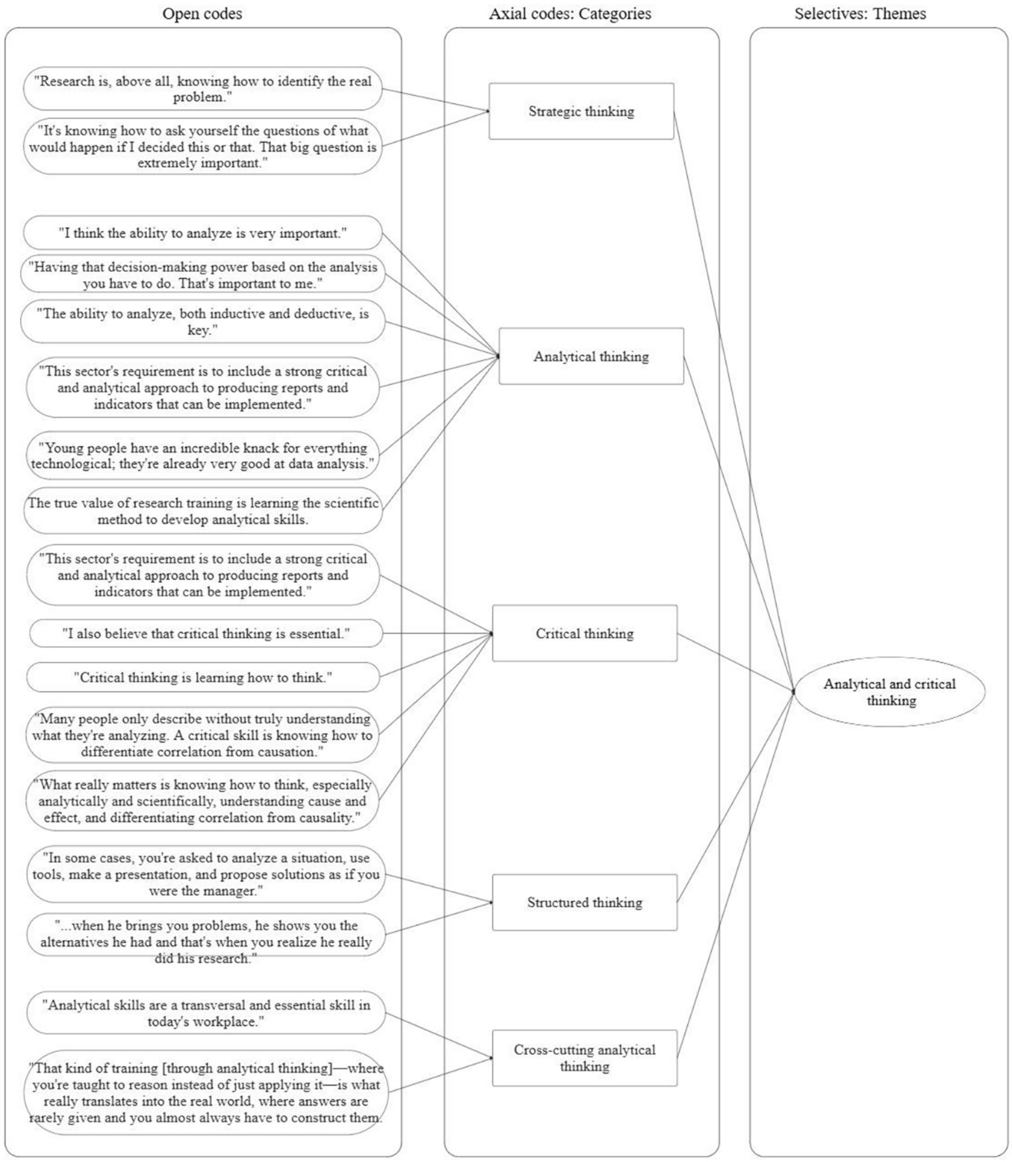

Fig. 4. Codes, categories, and themes identified for the analytical and critical thinking competency

Effective communication was discussed by employers. They considered that implementing undergraduate research experiences has a significant relevance for the development of this competency. They identified several related categories for this theme, such as effective communication, communication for professional performance, active listening, and communicative skills, as shown in Figure 5.

With respect to effective communication, employers stated this competency is essential at all levels. Professionals should be capable of expressing their ideas to stakeholders at all organizational levels, from entry-level to executive positions. Proficiency in adapting the speech to audiences is needed, as stated:

"Knowing how to communicate is also essential. Good ideas are useless if you don't know how to express them."

As for communication for professional performance, it is necessary for a variety of activities such as supporting projects and carrying out good interviews or even an argument. Effective communication is associated with convincing an audience. At the same time, it includes listening. In fact, employers identified active listening as an essential component of effective communication, highlighting its relevance for conflict resolution, especially at the management level. Finally, about communicative skills, employers identified communication as a requirement for professional development at all levels:

"At every level, the ability to communicate is vital."

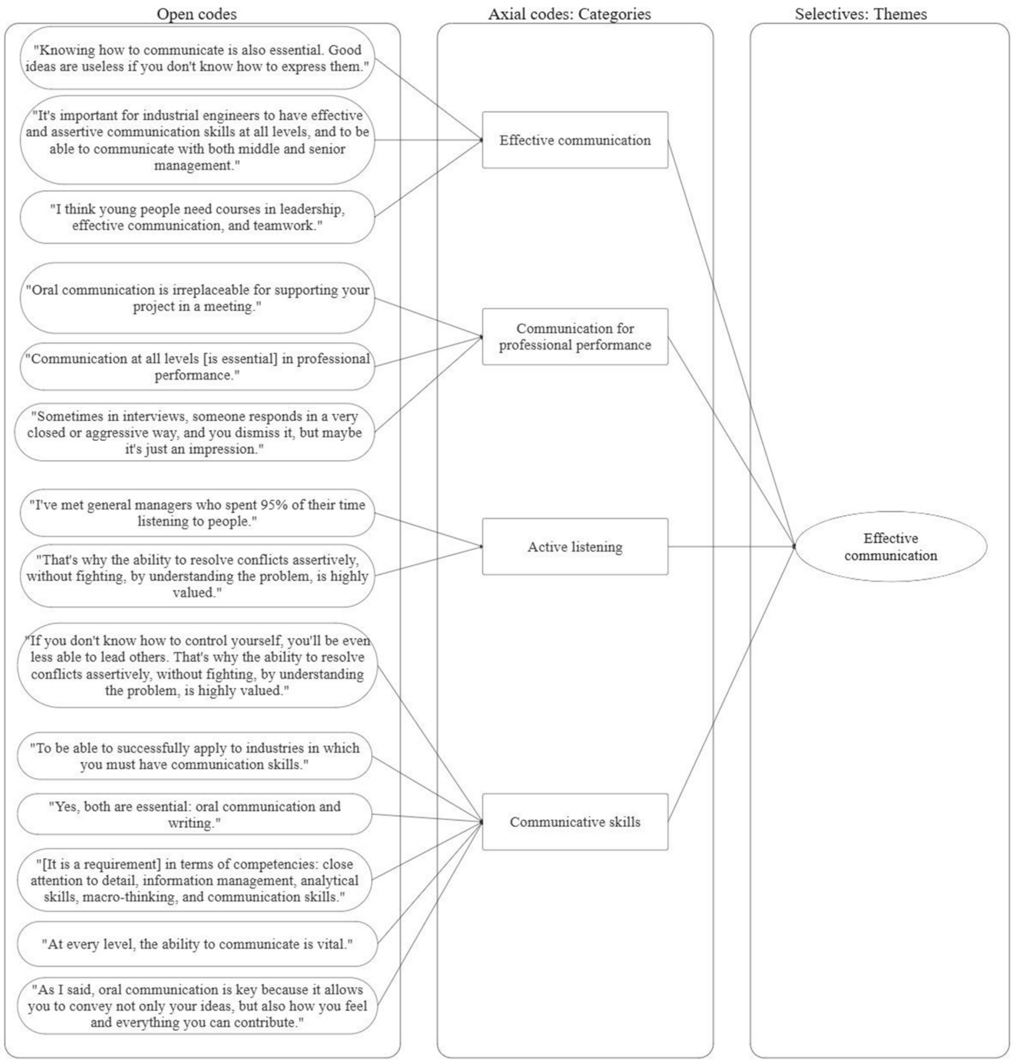

Fig. 5. Codes, categories, and themes identified for the effective communication competency

About teamwork, employers considered that implementing undergraduate research experiences has a significant relevance for the development of this competency. The most relevant categories identified for this theme were complementary competencies and multidisciplinary teams. Regarding multidisciplinary teams, employers stated that projects nowadays are developed by a variety of professionals who are expected to collaborate with each other, reason why teamwork has become more complex. As for complementary competencies, they recognized that teamwork is closely related to other competencies, such as effective communication, leadership, and organizational and management skills. They also identified teamwork as a generic competency necessary for the engineering professional field. However, they also acknowledged further training is needed for its development, as stated below:

> *"I think young people need courses in leadership, effective communication, and teamwork."*

Intellectual curiosity was also discussed by employers. They considered that undergraduate research experiences may also promote the development of this competency. Categories identified for this theme were: academic curiosity, technological support, and professional curiosity. As for technological support, employers stated that this curiosity is fostered by technology, as this can be a source to obtain information. Regarding academic curiosity, it is associated with creativity and a desire to continue learning, while professional curiosity may be transferred to students' academic path, as stated:

> *"[Research training] promotes intellectual curiosity."*
> *"Then, with that attitude, they began to better approach their profession."*

As for adaptability, employers stated that this competency may also be fostered by undergraduate research experiences. Categories identified for this theme included resilience, flexibility, and adaptability. Regarding resilience, employers recognized that adaptability is closely related to other competencies, such as emotional management, pressure management, and people management. They also identified adaptability as a generic competency necessary for the professional field. With respect to flexibility, employers considered that it leads to a stronger capacity to adapt to changing circumstances and unexpected challenges. This capacity allows individuals and teams to remain effective even in dynamic environments, ensuring that goals can still be met despite shifting priorities or unforeseen obstacles. Finally, when referring to adaptability, they acknowledged it is important that professionals are able to transform themselves according to the permanent cycle of constant changes of the environment:

> *"Adapting to generational changes is key."*

Finally, employers stated that developing digital literacy is highly relevant for enhancing professional performance across various sectors. In this regard, categories identified within this theme included: training in AI, the use of technological tools, and technology specific to each sector. With respect to the application of technological tools, professionals considered that automating is key now that artificial intelligence is used more. BIM methodology was pointed out as an example. In this line, with relation to the sector-specific technology, employers found it important for students to master it. For example, in construction, young engineers are expected to use tablets to transform virtual construction into a real one. Lastly, regarding training in AI, they stated that this is an emerging field that should be explored.

4.2 Survey

In the second stage of data collection, surveys were applied to graduates to determine their perceptions about their own research knowledge. To measure the variables, the survey was organized into four sections: (I) cognitive, (II) investigative, (III) methodological, and (IV) collaborative. Consequently, this subsection is organized according to these sections, that might as well be identified as dimensions.

Cognitive skills. Figure 6 presents the results obtained for the cognitive dimension, composed of six items: (1) identification of relevant problems in the environment for research development; (2) assessment of textual and non-textual information found in databases; (3) organization of information by topic, level, or category; (4) verification of the clarity and accuracy of the research writing; (5) ability to support arguments through citations, data, and relevant evidence; and (6) ability to coherently relate the components of the research.

Overall, graduates reported high levels of agreement across the dimension, particularly regarding the verification of clarity and accuracy in research writing (61.4% strongly agreed and 34.3% agreed), the support of arguments through citations, data, and relevant evidence (58.6% strongly and 31.4% agreed), and the coherent articulation of research components (53.6% strongly agreed and 37.9% agreed). Similarly, most participants perceived themselves as capable of identifying relevant research problems (44.3% strongly agreed and 44.3% agreed).

These findings suggest that graduates perceive themselves as possessing strong cognitive skills associated with questioning, critical analysis, and academic writing within research contexts. Nevertheless, a smaller proportion of neutral and negative responses was identified in the item related to the evaluation and organization of information from scientific databases (8.6% neither agreed nor disagreed, 5.7% disagreed, and 1.4% strongly disagreed) and the organization of information according to topics, levels, or categories (10.0% neither agreed nor disagreed, 5.7% disagreed, and 1.4% strongly disagreed), indicating opportunities to further strengthen these processes during undergraduate research training.

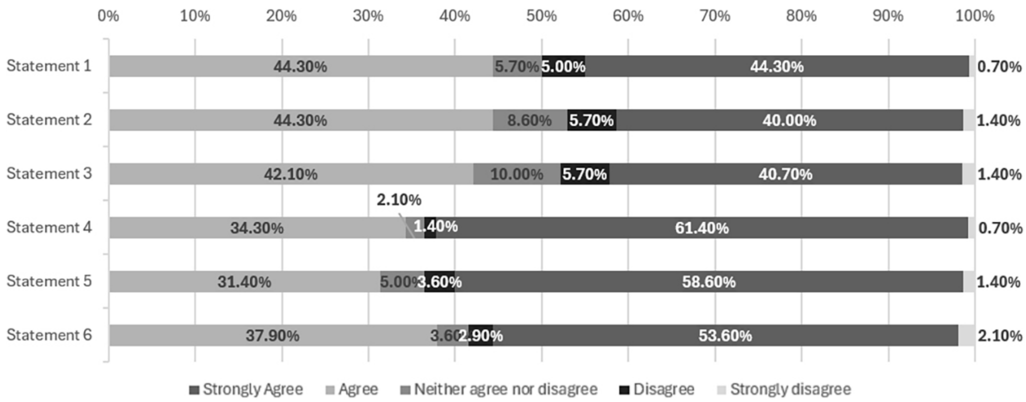

Fig. 6. Values obtained for engineering graduates' self-perceptions of cognitive skills

Note: The numbering on the vertical axis of the figure corresponds to the numbering of the questionnaire found in Table 4.

Investigative skills. Figure 7 presents the values obtained for the investigative dimension, composed of five items: (1) use of concepts and keywords for searching information in reliable sources; (2) search for information in reliable databases;

(3) use of reference managers to classify information; (4) use of ICT and AI to organize information; and (5) use of social networks to communicate research results.

Overall, graduates reported positive perceptions regarding the use of keywords (62.1% strongly agreed and 31.4% agreed) and reliable databases for information retrieval (47.9% strongly agreed and 34.3% agreed), as well as the use of ICT and AI tools to organize information (42.9% strongly agreed and 38.6% agreed). However, lower levels of agreement were identified in relation to the use of reference managers, such as Mendeley and Zotero, for classifying information (27.9% neither agreed nor disagreed, 19.3% disagreed, and 4.3% strongly disagreed) and the use of social networks, such as LinkedIn or Google Scholar, for disseminating research results (32.1% neither agreed nor disagreed, 19.3% disagreed, and 7.9% strongly disagreed). These findings suggest that, while graduates perceive strengths in information searching and organization, additional support may be needed to strengthen skills associated with the management of specialized research scientific tools and the communication of results.

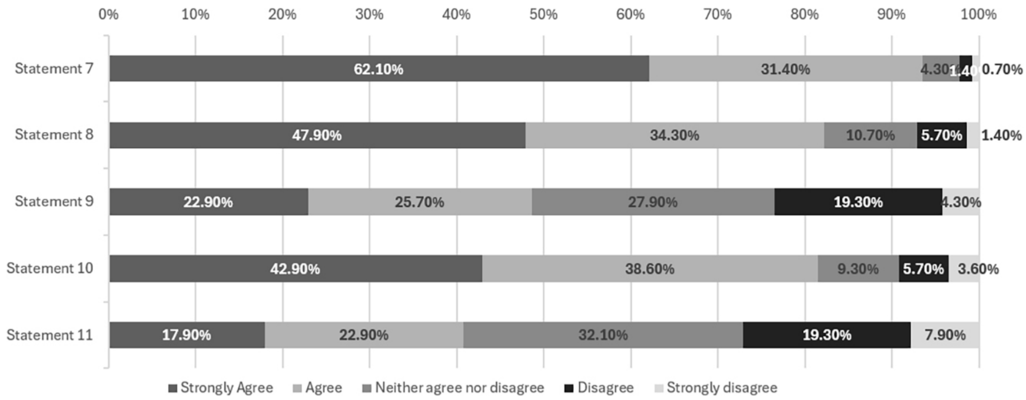

Fig. 7. Values obtained for engineering graduates' self-perceptions of investigative skills

Note: The numbering on the vertical axis of the figure corresponds to the numbering of the questionnaire found in Table 4.

Methodological skills. Figure 8 shows the values obtained for the methodological dimension, composed of twelve (12) items regarding the following abilities: (1) categorizing bibliographic sources relevant to the topic and identifying potential research challenges; (2) identifying a research challenge; (3) formulating a research problem and question; (4) defining the scope of research; (5) formulating research objectives; (6) consolidating a review of the state of the art on the study topic; (7) selecting relevant theories and theoretical foundations; (8) formulating hypotheses; (9) interpreting results; (10) developing conclusions; (11) suggesting recommendations; and (12) drafting documents with scientific-technical rigor.

Overall, graduates reported high levels of agreement across most methodological skills, particularly regarding the formulation of objectives (50.7% strongly agreed and 40% agreed) and hypotheses (42.9% strongly agreed and 47.1% agreed); the interpretation of results (47.9% strongly agreed and 45% agreed); the development of conclusions (45.7% strongly agreed and 45% agreed) and recommendations (51.4% strongly agreed and 37.1% agreed); and the definition of research scope (45.7% strongly agreed and 42.1% agreed).

Positive perceptions were also observed in relation to the construction of theoretical frameworks (46.4% strongly agreed and 40.7% agreed), the consolidation of a state of the art (41.4% strongly agreed and 41.4% agreed), and the formulation of a research problem (45% agreed and 43.6% agreed). Nevertheless, comparatively lower levels of agreement were identified in tasks associated with categorizing bibliographic sources (35% strongly agreed and 38.6%), identifying a research challenge (36.4% strongly agreed and 41.4% agreed) and drafting scientific documents with technical rigor (45% strongly agreed and 34.3% agreed), suggesting the need to further strengthen competencies related to scientific writing, questioning style of thinking, and literature management within undergraduate research training.

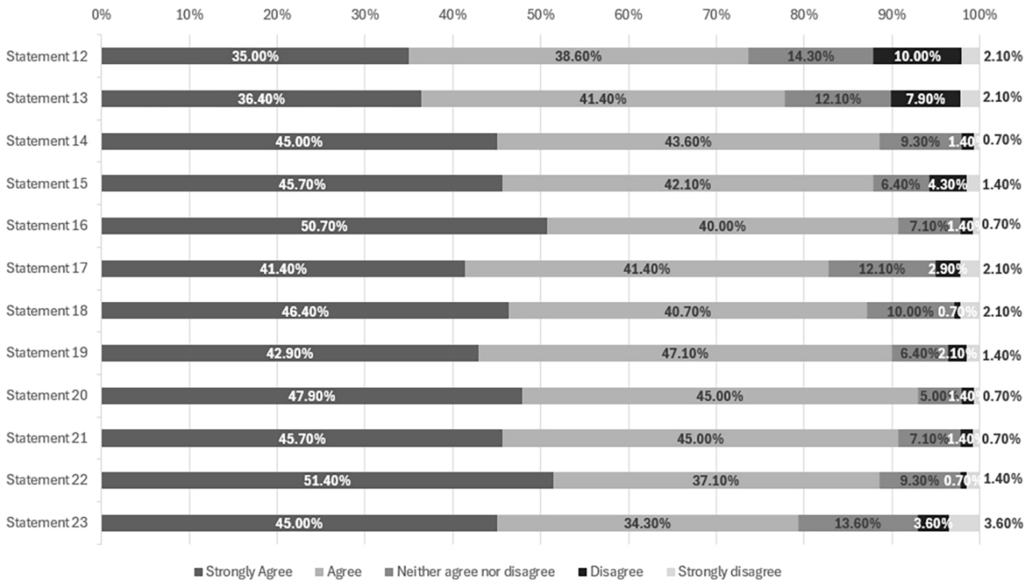

Fig. 8. Values obtained for engineering graduates' self-perceptions of methodological skills

Note: The numbering on the vertical axis of the figure corresponds to the numbering of the questionnaire found in Table 4.

Collaborative skills. Figure 9 shows the values obtained for the collaborative dimension, composed of six (6) items: (1) use of digital tools for communication and coordination with members of the research team; (2) use of virtual platforms to share, analyze, discuss, and build knowledge; (3) participation in every stage of research; (4) assumption of responsibility for fulfilling assigned tasks and collaborating with research team members; (5) recognition of team members' strengths for task allocation; and (6) consideration of others' points of view and constructive criticism.

Overall, graduates reported highly positive perceptions across all items, particularly regarding the use of virtual platforms for collaborative knowledge construction (57.9% strongly agreed and 31.4% agreed), the use of digital tools for communication and coordination (55.7% strongly agreed and 32.9% agreed), responsibility fulfillment (55% strongly agreed and 37.9% agreed) and the consideration of diverse perspectives during research processes (58.6% strongly agreed and 36.4% agreed). They also reported positive perceptions concerning participation (55.7% strongly agreed and 35.7% agreed) and recognition of others' strengths (50.7% strongly agreed and 40.7% agreed).

These findings suggest that graduates perceive themselves as possessing strong collaborative skills within research environments, especially in relation to teamwork, digital interaction, and effective communication. The consistently high levels of agreement across this dimension reinforce the relevance of undergraduate research experiences as spaces that may foster generic competencies.

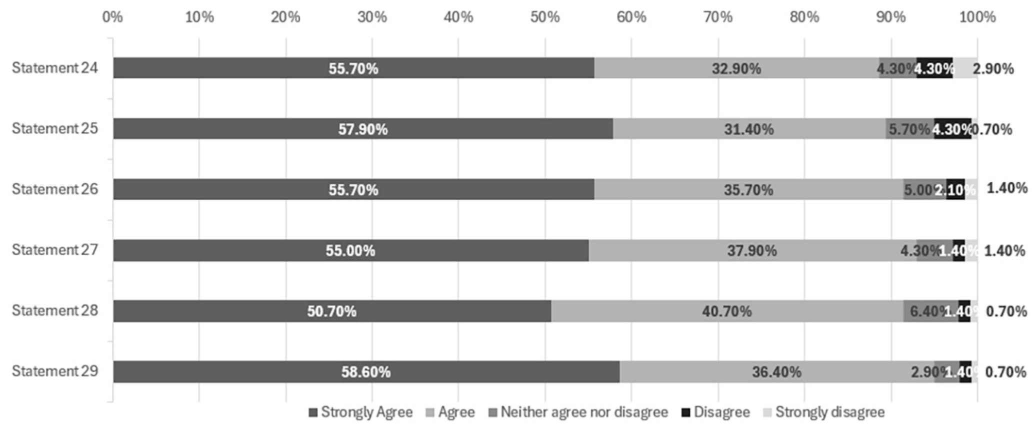

Fig. 9. Values obtained for engineering graduates' self-perceptions of collaborative skills

Note: The numbering on the vertical axis of the figure corresponds to the numbering of the questionnaire found in Table 4.

5 DISCUSSION

This section reports the findings derived from the two data collection techniques, interview and survey, which are presented in separate subsections, each corresponding to one method. Within each subsection, the results are discussed in relation to the specific objective it addresses.

5.1 Identification of the generic competencies most valued by employers and the gaps that need to be developed in engineering graduates

First, research competency emerged as the most prominent competency identified by employers, appearing 35 times as an emerging code during the interviews. Employers emphasized that undergraduate research experiences provide students with structured approaches to problem-solving that may later be transferred to professional practice. In this sense, research experiences integrated into the teaching–learning process allow students to engage with state-of-the-art disciplinary knowledge in a transversal manner [92].

Employers also highlighted the importance of fostering a research-oriented institutional culture to support the incorporation of undergraduate research experiences, strengthen academic productivity, and encourage the industry–academia synergy [48]. Previous studies have similarly suggested that RBL may enhance research skills while simultaneously supporting the perceived development of generic competencies [93]. Consequently, employers stressed the importance of strengthening research competency among undergraduate engineering students.

Furthermore, they also associated research competency with innovation capacity, reinforcing its relevance within contemporary engineering education and professional practice [94]. The findings also suggest that research competency may support the development of other generic competencies, particularly analytical and critical thinking, as well as LL [95].

Second, LL was also emphasized by employers, emerging twelve (12) times as a code during the interviews. They highlighted the role of this competency in bridging the gap between graduates' competencies and the continuous evolution of the labor market demands [96]. As reported by [41], LL equips professionals to cope with the challenges of economic globalization and to remain competitive. Similarly, [97] indicated that the ability to learn continuously and independently is valuable for multidisciplinary work, innovation, and expanding knowledge domains for career transitions. Employers shared this perspective, emphasizing that LL not only enhances employability [98] but also supports the development and application of meaningful knowledge and complementary competencies throughout professional practice.

Third, analytical and critical thinking emerged 13 times during the interviews, highlighting its relevance for engineering graduates. As previously discussed, employers emphasized that this competency is closely associated with undergraduate research experiences, since research processes encourage students to question their surroundings, evaluate information critically, and explore multiple approaches to problem-solving [105]. In this sense, employers perceived this competency as strongly interconnected with research competency and LL, as all three involve inquiry, continuous knowledge acquisition, reflection, and adaptability to changing professional environments. This perspective reinforces previous findings suggesting that analytical and critical thinking may be strengthened through research experiences at different educational levels [99].

Employers also acknowledged that higher education institutions generally provide solid preparation in analytical and critical thinking across engineering specialties. Nevertheless, they stressed the importance of continuing to reinforce it among engineering students due to their relevance for collaboration, idea exchange, and the generation of innovative solutions within professional contexts [95]. Furthermore, analytical and critical thinking has been associated with processes of information searching, selection, and critical evaluation, which are particularly relevant undergraduate research environments [106].

Fourth, employers particularly valued interpersonal competencies, especially effective communication, which emerged 21 times during the interviews, and teamwork, which emerged 18 times. Rather than functioning independently, employers emphasized that these competencies complement one another, contributing to a more comprehensive professional profile in engineering education, as stated by [90]. Their relevance to organizations is associated with employability [88] and professional performance [41] within increasingly collaborative work environments.

Certainly, [41] and [89] corroborated the importance of developing teamwork in engineering professionals, while [8] and [88] revealed that effective communication is needed to allow proper interaction, providing professionals with tools for argumentation and preparing them to exchange ideas within multidisciplinary contexts.

In this regard, employers highlighted the need to strengthen curricular opportunities that foster teamwork and effective communication among future engineers, demonstrating the importance of strengthening these competencies in engineering students. This concern reflects broader discussions regarding undergraduate training quality and the persistent challenges associated with the development of generic competencies [91].

Finally, employers also emphasized complementary competencies associated with professional adaptability and continuous development: intellectual curiosity, adaptability, and digital literacy. Intellectual curiosity emerged 15 times during the interviews and was associated with motivation for knowledge acquisition and proactive engagement with professional challenges. Employers perceived this competency as closely related to research competency, LL, and analytical and critical thinking, since curiosity encourages inquiry, stimulates reflective thinking, and supports professional growth [99]. Previous studies have similarly linked intellectual curiosity to confidence development, creative thinking, perseverance, and problem-solving [24, 100, 101]. In this regard, employers stressed the importance of further strengthening this competency among engineering students due to its relevance for addressing workplace challenges and fostering innovation-oriented attitudes.

Adaptability, which emerged five times during the interviews, was also considered essential within dynamic and constantly evolving professional environments. Employers emphasized that adaptability enables professionals to respond effectively to shifting priorities and organizational challenges through flexibility and resilience [102]. Furthermore, this competency was perceived as strongly connected to LL and the development of other generic competencies, particularly creativity, innovation, and problem-solving [102, 103]. Employers also highlighted that strengthening adaptability may expand graduates' employment opportunities across different organizational contexts [104].

Likewise, digital literacy emerged as a relevant competency for contemporary engineering practice, appearing 10 times during the interviews. Employers associated digital literacy with the effective management of digital tools, adaptation to technological innovations, and the optimization of organizational processes that support productivity and innovation [103, 104, 107]. Previous studies have similarly suggested that this competency facilitates information management and continuous professional training in response to evolving societal and labor market demands [107, 108, 109]. In this sense, employers perceived digital literacy as increasingly interconnected with research competency, LL, and adaptability within technology-driven professional environments.

5.2 Perception of research knowledge levels among engineering graduates

Cognitive skills. Cognitive skills may be defined as the abilities that allow acquiring, processing, storing, and transforming information. According to literature, these skills are essential for research because they involve logical reasoning and flexible thinking, facilitating decision-making and problem-solving processes [110].

The findings revealed high self-perceived levels of cognitive skills among engineering graduates. Graduates particularly reported strong self-perceptions regarding the verification of clarity and accuracy in research writing, the support of arguments through evidence and citations, and the coherent articulation of research components. Positive self-perceptions were also identified in relation to problem identification, information evaluation, and information organization.

These findings suggest that undergraduate research training may support the perceived development of critical and analytical thinking by exposing students to research-oriented tasks involving information management, argumentation, and problem-solving processes. In this sense, the quantitative findings complement the employers' perceptions obtained during the qualitative stage, where analytical and critical thinking was identified as a highly valuable competency for engineering graduates.

Previous studies have similarly suggested that RBL facilitates the understanding of complex theoretical concepts while fostering analytical and critical thinking [90].

Likewise, undergraduate research experiences have been associated with students' ability to critically evaluate information and apply knowledge in authentic academic and professional contexts [69]. Collectively, these findings reinforce the relevance of implementing undergraduate research experiences for supporting cognitive skills development, and thereby generic competencies, in engineering education.

Investigative skills. Investigative skills refer to the abilities that enable the understanding and explanation of phenomena through inquiry, experimentation, and hypothesis testing. According to the literature, these skills are essential for research because they strengthen critical, analytical, and reflective thinking [111].

Overall, graduates reported positive self-perceptions regarding investigative skills, particularly in relation to information retrieval through keywords and reliable databases, as well as the use of ICT and AI tools to organize information. Nevertheless, comparatively lower levels of agreement were identified regarding the use of reference management software and social media for communicating research results.

These findings suggest that undergraduate research training may provide solid foundations for information searching and organization, while simultaneously revealing opportunities to strengthen abilities associated with scientific dissemination and specialized research tools. This pattern is consistent with the qualitative findings, in which employers highlighted the importance of reinforcing effective communication to properly disseminate research outcomes.

Previous studies have similarly indicated that undergraduate research experiences may strengthen both research competency and other generic competencies essential for professional performance, such as LL [93]. In particular, research-oriented learning environments have been associated with improvements in information-searching processes and the management of academic sources [105]. These findings reinforce the importance of consolidating research training strategies that support not only information management but also scientific communication within engineering education.

Methodological skills. Methodological skills may be defined as the ability to approach research questions in a systematic, controlled, and organized manner, while translating theoretical aspects into practical applications and critically examining the information obtained. According to literature, these skills are fundamental for conducting structured and rigorous research processes [112].

The findings revealed consistently high self-perceived levels of methodological skills among engineering graduates. Stronger perceptions were identified in competencies related to formulating objectives and hypotheses, interpreting results, developing conclusions and recommendations, and defining research scope. Positive perceptions were also observed regarding the consolidation of a review of the state of the art, construction of theoretical frameworks, and the contextualization of a research problem.

Nevertheless, comparatively lower levels of agreement emerged in abilities associated with categorizing bibliographic sources, identifying research challenges, and drafting scientific documents with technical rigor. These findings suggest that, while undergraduate research experiences may contribute to the perceived development of methodological skills, additional reinforcement may still be needed in scientific writing, questioning style of thinking, and literature management processes.

Previous studies have similarly emphasized that undergraduate research experiences involve activities such as problem formulation, literature review, data collection, analysis, interpretation, and communication of findings [8]. Likewise, formative research has been associated with the strengthening of methodological skills among university students [113]. In this sense, the findings suggest that research-oriented learning environments may facilitate the integration of theoretical knowledge with practical inquiry processes, supporting the perceived development of methodological skills in engineering education.

Collaborative skills. Collaborative skills can be defined as the ability to coordinate actions with others in pursuit of shared goals through cooperation, communication, trust, and a focus on mutual benefit [93, 110]. According to literature, collaborative skills are essential for research because they facilitate effective communication, openness, trust, and creative thinking [24, 110].

The findings revealed highly positive self-perceptions regarding collaborative skills across all items within the dimension. Graduates particularly reported strong self-perceptions concerning the consideration of diverse perspectives during research processes, responsibility fulfillment, the recognition of others' potential; teamwork coordination; and the use of digital tools and virtual platforms to communicate and build knowledge.

These findings suggest that undergraduate research experiences may foster collaborative learning environments where competencies like effective communication, digital literacy, and teamwork are actively promoted. This result is consistent with the qualitative findings, in which employers emphasized teamwork and effective communication as essential competencies for professional engineering practice.

Previous studies have similarly suggested that collaborative practices contribute to the development of teamwork and effective communication competencies and facilitate effective interaction within multidisciplinary professional environments [95, 114, 115, 116, 117]. In this regard, research-oriented learning environments may support the perceived development of collaborative skills by engaging students in shared inquiry processes that resemble professional and organizational dynamics.

6 CONCLUSIONS

The findings of this study suggest a perceived association between undergraduate research training and the development of generic competencies among engineering graduates in Lima, Peru, particularly regarding cognitive, investigative, methodological, and collaborative skills, which are considered essential for professional integration and performance.

Regarding the first specific objective, employers identified research competency, LL, analytical and critical thinking, teamwork, effective communication, intellectual curiosity, adaptability, and digital literacy as highly valuable for engineering graduates. Rather than functioning independently, these competencies were perceived as strongly interconnected, collectively supporting graduates' capacity to respond to changing and highly technological professional environments. Nevertheless, perceived gaps were also identified, especially regarding effective communication, adaptability, and intellectual curiosity, suggesting the need to further strengthen curricular and institutional strategies aimed at supporting the development of generic competencies in engineering education.

With respect to the second specific objective, the findings revealed that graduates reported high self-perceived levels of research knowledge, particularly regarding cognitive, investigative, methodological, and collaborative skills. These perceptions suggest that undergraduate research training may support the development of competencies associated with critical analysis, information management, the application of scientific methodologies, and collaboration. Furthermore, the quantitative findings complemented the qualitative results, as both graduates and employers highlighted the relevance of competencies linked to research within engineering education and professional practice: effective communication, analytical and critical thinking, and teamwork. Nevertheless, the comparatively lower perceptions identified in the use of reference management tools and scientific communication strategies suggest the need to further strengthen technical training associated with applied research and research dissemination processes.

Taken together, the findings suggest that undergraduate research training is perceived as contributing to the development of generic competencies associated not only with academic performance but also employability, innovation, and professional adaptability in engineering contexts. In particular, competencies such as effective communication, teamwork, analytical and critical thinking, LL, and research competency emerged as strongly interconnected within both the qualitative and quantitative findings. Consequently, universities are encouraged to strengthen institutional research cultures oriented toward active learning and competency-based education, thereby enhancing the relevance of academic training in response to labor market demands and the challenges of the knowledge society.

However, the findings should be interpreted considering the limitations of the study: first, the qualitative component included only 10 employers. Thus, the findings cannot be generalized to all engineering employers or industries. Second, the quantitative sample of graduates was unevenly distributed across engineering programs, with a predominance of Industrial Engineering graduates. Consequently, the perceptions reported in the survey may reflect, to a greater extent, the experiences and training characteristics associated with that discipline. Finally, because the study was conducted within a single private university in Lima, Peru, the findings should be interpreted within this specific institutional context and should not be generalized broadly to other STEM higher education programs.

In this regard, future research could involve larger and more balanced samples from engineering programs at other STEM-oriented higher education institutions. Studies involving a more proportional representation of disciplines would allow for a more comprehensive understanding of how undergraduate research training is perceived. Expanding the number and diversity of employers participating could also provide broader insights into labor market expectations regarding generic competencies.

Explanatory research may also facilitate further analysis of potential associations, differences, and contextual factors related to the perceived development of generic competencies through undergraduate research training. Finally, future studies may also benefit from longitudinal or comparative designs, as well as from the inclusion of direct assessments of research knowledge, including performance-based evaluations, portfolio analysis, or external assessments, to complement self-perception data with objective measurements. This may provide a deeper understanding of the relationship between undergraduate research training and generic competencies.

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8 REFERENCES

[1] F. González-Ferriz, "Integrating challenge-based learning and agile methodologies to transform vocational training," *RAN – Revista Academia & Negocios*, vol. 11, no. 1, pp. 1–14, 2025. https://doi.org/10.29393/RAN11-9IBGF10009

[2] C. N. G. Curipoma, M. E. N. Ocampo, D. P. C. Cajilima, and S. R. T. Peralta, "Metodologías activas en el proceso de enseñanza-aprendizaje: Implicaciones y beneficios," *Ciencia Latina Revista Científica Multidisciplinar*, vol. 7, no. 3, pp. 3311–3327, 2023. https://doi.org/10.37811/cl_rcm.v7i3.6409

[3] A. Ortiz. *Modelos pedagógicos y teorías del aprendizaje*. Bogotá: Ediciones de la U. 2013.

[4] K. Samuelowicz and J. Bain, "Revisiting academics' beliefs about teaching and learning," *Higher Education*, vol. 41, no. 3, pp. 299–325, 2001. https://doi.org/10.1023/A:1004130031247

[5] L. Abrahamzon Garcia, K. Galantini Velarde, and A. F. Luna Torres, "Augmented reality for the development and reinforcement of spatial skills: A case applied to civil engineering students," *International Journal of Engineering Pedagogy*, vol. 14, no. 5, pp. 88–108, 2024. https://doi.org/10.3991/ijep.v14i5.47473

[6] M. Labrador and M. Andreu, "Metodologías activas," Ediciones Universidad Politécnica de Valencia, 2008.

[7] T. Van Woezik, J. Koksma, R. Reuzel, D. Jaarsma, and G. Van der Wilt, "How to encourage a lifelong learner? The complex relation between learning strategies and assessment in a medical curriculum," *Assessment & Evaluation in Higher Education*, vol. 45, no. 4, pp. 513–526, 2020. https://doi.org/10.1080/02602938.2019.1667954

[8] A. A. Del Savio, L. Cáceres, and K. Galantini, "A methodology for embedding research competencies in an undergraduate civil engineering program," *International Journal of Engineering Education*, vol. 37, no. 5, pp. 1201–1214, 2021. https://hdl.handle.net/20.500.12724/14105

[9] I. Made Sudana, D. Apriyani, and S. Nurmasitah, "Revitalization of vocational high school roadmap to encounter the 4.0 industrial revolution," *Journal of Social Sciences Research*, vol. 5, no. 2, pp. 338–342, 2019. https://doi.org/10.32861/jssr.52.338.342

[10] D. Das, "Problem-based learning for undergraduate civil engineering education in South Africa—A methodological approach," in *Lecture Notes in Civil Engineering*, Singapore: Springer, 2023, pp. 85–95. https://doi.org/10.1007/978-981-19-0503-2_8

[11] M. Imran, T. F. Halawa, M. Baig, A. M. Almanjoumi, M. M. Badri, and W. A. Alghamdi, "Team-based learning versus interactive lecture in achieving learning outcomes and improving clinical reasoning skills: A randomized crossover study," *BMC Medical Education*, vol. 22, no. 1, pp. 1–9, 2022. https://doi.org/10.1186/s12909-022-03411-w

[12] J. Noguez and L. Neri, "Research-based learning: A case study for engineering students," *International Journal on Interactive Design and Manufacturing*, vol. 13, pp. 1283–1295, 2019. https://doi.org/10.1007/s12008-019-00570-x

[13] K. Galantini Velarde, V. Briceño Weiss, M. Aguinaga Villegas, L. Abrahamzon Garcia, and A. A. Del Savio, "Undergraduate research for the development of generic competencies: A study of a civil engineering program," *Journal of Civil Engineering Education*, vol. 152, no. 3, p. 04026002, 2026. https://doi.org/10.1061/JCEECD.EIENG-2294

[14] C. Mugruza-Vassallo, "Integral and transformative engineering coursework in formative research for undergraduate curricula," in *IEEE Frontiers in Education Conference (FIE)*, Erie, PA, USA, 2016, pp. 1–8. https://doi.org/10.1109/FIE.2016.7757633

[15] S. Halawa, Y.-S. Hsu, and W.-X. Zhang, "Analysis of physics textbooks through the lens of inquiry practices," *The Asia-Pacific Education Researcher*, vol. 32, no. 4, pp. 497–506, 2023. https://doi.org/10.1007/s40299-022-00671-4

[16] National Research Council. *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. The National Academies Press, 2012.

[17] National Research Council. *Monitoring Progress Toward Successful K-12 STEM Education: A Nation Advancing?* National Academies Press, 2013. https://doi.org/10.17226/13509

[18] G. M. Sinatra, A. Mukhopadhyay, T. N. Allbright, J. A. Marsh, and M. S. Polikoff, "Speedometry: A vehicle for promoting interest and engagement through integrated STEM instruction," *Journal of Educational Research*, vol. 110, no. 3, pp. 308–316, 2017. https://doi.org/10.1080/00220671.2016.1273178

[19] Z. Smyrnaiou, E. Georgakopoulou, and S. Sotiriou, "Promoting a mixed-design model of scientific creativity through digital storytelling—the CCQ model for creativity," *International Journal of STEM Education*, vol. 7, no. 1, p. 25, 2020. https://doi.org/10.1186/s40594-020-00223-6

[20] Z. Öcek *et al.*, "A research training program in a Turkish medical school: Challenges, barriers and opportunities from the perspectives of the students and faculty members," *BMC Medical Education*, vol. 21, no. 1, p. 2, 2021. https://doi.org/10.1186/s12909-020-02454-1

[21] N. G. Lederman and L. S. Lederman, "Nature of scientific knowledge and scientific inquiry: Instructional capacity through professional development," in *Second International Handbook of Science Education*, B. J. Fraser, K. Tobin, and C. J. McRobbie, Eds., The Netherlands: Springer, Dordrecht, 2012, pp. 335–359. https://doi.org/10.1007/978-1-4020-9041-7_24

[22] R. W. Bybee, "Advancing STEM education: A 2020 vision," *Technology and Engineering Teacher*, vol. 70, no. 1, pp. 30–35, 2010.

[23] S. Halawa, Y.-S. Hsu, W.-X. Zhang, Y.-R. Kuo, and J.-Y. Wu, "Features and trends of teaching strategies for scientific practices from a review of 2008–2017 articles," *International Journal of Science Education*, vol. 42, no. 7, pp. 1183–1206, 2020. https://doi.org/10.1080/09500693.2020.1752415

[24] M. Y. Beckman and N. Y. Hensel, "Making explicit the implicit: Defining undergraduate research," *CUR Quarterly*, vol. 29, pp. 40–44, 2009.

[25] M. Grangeat, C. Harrison, and J. Dolin, "Exploring assessment in STEM inquiry learning classrooms," *International Journal of Science Education*, vol. 43, no. 3, pp. 345–361, 2021. https://doi.org/10.1080/09500693.2021.1903617

[26] M. K. Eagan, S. Hurtado, M. J. Chang, G. A. Garcia, F. A. Herrera, and J. C. Garibay, "Making a difference in science education: The impact of undergraduate research programs," *American Educational Research Journal*, vol. 50, no. 4, pp. 683–713, 2013. https://doi.org/10.3102/0002831213482038

[27] H. Khazragui and J. Hudson, "Measuring the benefits of university research: Impact and the REF in the UK," *Research Evaluation*, vol. 24, no. 1, pp. 51–62, 2015. https://doi.org/10.1093/reseval/rvu028

[28] G. Crebert, M. Bates, B. Bell, C. P. Patrick, and V. Cragnolini, "Developing generic skills at university, during work placement and in employment: Graduates' perception," *Higher Education Research & Development*, vol. 23, no. 2, pp. 147–165, 2004. https://doi.org/10.1080/0729436042000206636

[29] UNESCO, "El futuro de la Educación Superior. Propuestas globales para la III Conferencia Mundial de Educación Superior de la UNESCO 2022," 2022.

[30] M. Leandro Cruz, G. Saunders-Smits, and P. Groen, "Evaluation of competency methods in engineering education: A systematic review," *European Journal of Engineering Education*, vol. 45, no. 5, pp. 729–757, 2020. https://doi.org/10.1080/03043797.2019.1671810

[31] J. H. Flores, "Proyecto Tuning América Latina. Reflexiones y perspectivas de la Educación Superior en América Latina: Informe Final 2004–2007, Universidad Deusto-Universidad de Groningen, Bilbao, 2007, 427 páginas," *Diálogos*, vol. 2008, no. 2, pp. 68–70, 2023. https://doi.org/10.5377/dialogos.v1i2.16201

[32] H. Karimi and A. Pina, "Strategically addressing the soft skills gap among STEM undergraduates," *Journal of Research in STEM Education*, vol. 7, no. 1, pp. 21–46, 2021. https://doi.org/10.51355/jstem.2021.99

[33] Organization for Economic Co-Operation and Development (OCDE), "La definición y selección de competencias clave," *Resumen ejecutivo*, 2005.

[34] J. J. Kemp and L. Seagraves, "Transferable skills—can higher education deliver?" *Studies in Higher Education*, vol. 20, no. 3, pp. 315–328, 1995. https://doi.org/10.1080/03075079512331381585

[35] L. J. M. Shuman Besterfield-Sacre and J. McGourty, "The ABET 'professional skills'—can they be taught? Can they be assessed?" *Journal of Engineering Education*, vol. 94, no. 1, pp. 41–55, 2005. https://doi.org/10.1002/j.2168-9830.2005.tb00828.x

[36] C. G. Knobbs and D. J. Grayson, "An approach to developing independent learning and non-technical skills amongst final year mining engineering students," *European Journal of Engineering Education*, vol. 37, no. 3, pp. 307–320, 2012. https://doi.org/10.1080/03043797.2012.684673

[37] I. Markes, "A review of literature on employability skill needs in engineering," *Eur. J. Eng. Educ*., vol. 31, no. 6, pp. 637–650, 2006. https://doi.org/10.1080/03043790600911704

[38] L. Villardón-Gallego, *Competencias genéricas en educación superior: Metodologías específicas para su desarrollo*. Narcea Ediciones, 2015.

[39] T. Yu, W. Shang, S. Liu, and J. Zhu, "How to assess generic competencies: From sustainable development needs among engineering graduates in industry," *Sustainability*, vol. 14, no. 15, p. 9270, 2022. https://doi.org/10.3390/su14159270

[40] UNESCO. *La nueva dinámica de la educación superior y la investigación para el cambio social y el desarrollo*. París: UNESCO. 2009.

[41] C. J. Bucarey, S. M. Pérez, M. G. Marín, and L. A. Castillo, "Brechas en percepción de contribución de competencias genéricas entre estudiantes en Chile," *Revista de Ciencias Sociales*, vol. 29, no. 1, pp. 386–403, 2023. https://doi.org/10.31876/rcs.v29i1.39758

[42] I. Kostikova, L. Holubnycha, Z. Girich, and N. Movmyga, "Desarrollo de habilidades blandas con estudiantes universitarios en clases de inglés," *Revista Romaneasca pentru Educatie Multidimensionala*, vol. 13, no. 1, pp. 398–416, 2021. https://doi.org/10.18662/rrem/13.1/378

[43] C. Succi and M. Canovi, "Soft skills to enhance graduate employability: Comparing students and employers' perceptions," *Studies in Higher Education*, vol. 45, no. 9, pp. 1834–1847, 2020. https://doi.org/10.1080/03075079.2019.1585420

[44] A. R. Butz and J. L. Branchaw, "Entering research learning assessment (ERLA): Validity evidence for an instrument to measure undergraduate and graduate research trainee development," *CBE Life Sciences Education*, vol. 19, no. 2, 2020. https://doi.org/10.1187/cbe.19-07-0146

[45] C. J. Faber *et al.*, "Undergraduate engineering students' perceptions of research and researchers," *J. Eng. Educ*., vol. 109, pp. 780–800, 2020. https://doi.org/10.1002/jee.20359

[46] O. A. Adedokun, D. Zhang, L. C. Parker, A. Bessenbacher, A. Childress, and W. D. Burgess, "Understanding how undergraduate research experiences influence student aspirations for research careers and graduate education," *J. Coll. Sci. Teach*., vol. 42, pp. 82–90, 2012.

[47] A. Hunter, S. L. Laursen, and E. Seymour, "Becoming a scientist: The role of undergraduate research in students' cognitive, personal, and professional development," *Science Education*, vol. 91, no. 1, pp. 36–74, 2026. https://doi.org/10.1002/sce.20173

[48] Y. Ahmed, M. H. Taha, and S. Khayal, "Integrating research and teaching in medical education: Challenges, strategies, and implications for healthcare," *Journal of Advances in Medical Education & Professionalism*, vol. 12, no. 1, pp. 1–7, 2024. https://doi.org/10.30476/jamp.2023.99751.1854

[49] A. A. Del Savio, K. Galantini Velarde, L. Cáceres Montero, and M. A. Vergara Olivera, "A research training: Unraveling the research methodological design challenge in engineering programs," *International Journal of Engineering Pedagogy*, vol. 14, no. 7, pp. 30–53, 2024. https://doi.org/10.3991/ijep.v14i7.48987

[50] T. Casci and E. Adams, "Research culture: Setting the right tone," *eLife*, vol. 9, p. e55543, 2020. https://doi.org/10.7554/eLife.55543

[51] L. Hesli and J. M. Lee, "Faculty research productivity: Why do some of our colleagues publish more than others?" *PS Polit. Sci. Polit.*, vol. 44, no. 2, pp. 393–408, 2011. https://doi.org/10.1017/S1049096511000242

[52] I. D. Rojas Arenas, J. A. Durango Marín, and J. A. Rentería Vera, "Investigación formativa como estrategia pedagógica: caso de studio: ingeniería industrial de la I.U Pascual Bravo," Estudios Pedagógicos, vol. 46, no. 1, pp. 319–338, 2020. https://doi.org/10.4067/S0718-07052020000100319

[53] The Royal Society of London, "Research Culture," 2020. Available at https://royalsociety.org/topics-policy/projects/research-culture/

[54] E. Tikhonova and L. Raitskaya, "The culture of research: A systematic scoping review," *Journal of Language and Education*, vol. 10, no. 1, pp. 5–24, 2024. https://doi.org/10.17323/jle.2024.21526

[55] Z. A. Mamytbayeva, E. A. Orynbetova, U. K. Kyyakbayeva, K. Y. Yeralin, and A. K. Yeralina, "Bases para conformar la cultura investigativa de los futuros docentes-educadores en las instituciones de educación superior," *Bordón. Revista De Pedagogía*, vol. 76, no. 1, pp. 99–117, 2024. https://doi.org/10.13042/Bordon.2024.97666

[56] F. Callard, "Towards a critical-conceptual analysis of 'research culture'," *Area*, 2023. https://doi.org/10.1111/area.12905

[57] R. Meregildo-Gómez, R. Mas-Sandoval, R. Cruz-Aguilar, and L. Yglesias, "Construcción y análisis estructural de una escala para medir la cultura investigativa en universitarios peruanos," *Revista Internacional de Humanidades*, vol. 21, no. 2, pp. 477–492, 2023. https://doi.org/10.37467/revhuman.v21.5083

[58] R. González-Díaz, A. Acevedo-Duque, V. Martin-Fiorino, and E. Cachicatari-Vargas, "Latin American professors' research culture in the digital age," *Comunicar*, vol. 70, pp. 71–83, 2022. https://doi.org/10.3916/C70-2022-06

[59] L. Díez, J. Valencia, and E. Villa, "Promoción de la cultura investigativa como motor de desarrollo económico y social: una visión sistémica," *Espacios*, vol. 36, no. 1, 2015.

[60] B. Tucker and C. Tilt, "'You know it when you see it': In search of 'the ideal' research culture in university accounting faculties," *Critical Perspectives on Accounting*, vol. 64, 2019. https://doi.org/10.1016/j.cpa.2019.01.001

[61] H. T. L. Nguyen and T. Marjori-Banks, "Developing a university research culture in Vietnam: A leadership conceptual frame-work," in *Asia in Transition*, vol. 15, 2021, pp. 209–233. https://doi.org/10.1007/978-981-16-5055-0_12

[62] E. Iweka and R. Hyde, "Promotion of research culture among radiographers in one UK NHS trust through journal club activities – An autoethnographic study," *Radiography*, vol. 29, pp. 800–806, 2023. https://doi.org/10.1016/j.radi.2023.05.014

[63] S. M. Berrocal Villegas, W. Montalvo Fritas, C. R. Berrocal Villegas, V. R. Flores Rosas, and F. A. Jaimes Yabar, "Caracterización y desafíos de la cultura investigativa en dos universidades estatales de Lima, Perú," *Revista Universidad y Sociedad*, vol. 14, no. 1, pp. 375–383, 2022.

[64] G. Valkenburg, G. Dix, J. Tijdink, and S. de Rijcke, "Expanding research integrity: A cultural-practice perspective," *Science and Engineering Ethics*, vol. 27, no. 1, 2021. https://doi.org/10.1007/s11948-021-00291-z

[65] A. S. Lodhi, "A pilot study of researching the research culture in Pakistani public universities: The academics' perspective," *Procedia – Social and Behavioral Sciences*, vol. 31, pp. 473–479, 2012. https://doi.org/10.1016/j.sbspro.2011.12.089

[66] J. A. Halstead, "Council on undergraduate research: A resource (and a community) for science educators," *Journal of Chemical Education*, vol. 74, no. 2, p. 148, 1997. https://doi.org/10.1021/ed074p148

[67] L. Huber, "Forschungsbasiertes, Forschungsorientiertes, Forschendes Lernen: Alles dasselbe? Ein Pl ädoyer für eine Verst ändigung über Begriffe und Unterscheidungen im Feld forschungsnahen Lehrens und Lernens," *Das Hochschulwesen*, vol. 62, no. 1, pp. 22–29, 2014. Retrieved from https://www.fh-potsdam.de/fileadmin/user_upload/forschen/material-publikation/HSW1_2_2014_Huber.pdf

[68] I. Wessels, J. Rueß, C. Gess, W. Deicke, and M. Ziegler, "Is research-based learning effective? Evidence from a pre–post analysis in the social sciences," *Studies in Higher Education*, vol. 12, pp. 2595–2609, 2021. https://doi.org/10.1080/03075079.2020.1739014

[69] F. Espinoza-Figueroa, D. Vanneste, B. Alvarado-Vanegas, K. Farfán-Pacheco, and S. Rodriguez-Giron, "Research-based learning (RBL): Added-value in tourism education," *Journal of Hospitality, Leisure, Sport and Tourism Education*, vol. 28, p. 100312, 2021. https://doi.org/10.1016/j.jhlste.2021.100312

[70] S. Laursen, A.-B. Hunter, E. Seymour, H. Thiry, and G. Melton, *Undergraduate Research in the Sciences: Engaging Students in Real Science*. Hoboken, NJ: Wiley: 2010.

[71] A. Peachey and S. L. Baller, "Ideas and approaches for teaching undergraduate research methods in the health sciences," *Int. J. Learn. High. Educ.*, vol. 27, no. 3, pp. 434–442, 2015.

[72] K. Galantini Velarde, L. Cáceres Montero, and A. Pachas, "Peer learning and research culture within student organizations in engineering: Students' perceptions," *J. Eng. Educ. Transform.*, vol. 38, no. 1, pp. 109–121, 2024. https://doi.org/10.16920/jeet/2024/v38i1/24179

[73] R. V. Miche and R. De Armas Urquiza, "Tuning-América Latina y su compatibilidad con el modelo curricular Cubano," *Reencuentro—Universidad Autónoma Metropolitana*, vol. 54, pp. 73–82, 2009.

[74] M. Kupryaeva, O. Mamai, L. Panofenova, S. Syreskina, and N. Chigina, "Soft skills development in personnel training," in *Proc., E3S Web Conf.*, vol. 273, 2021, p. 12017. https://doi.org/10.1051/e3sconf/202127312017

[75] C. K. Y. Chan, E. T. Y. Fong, L. Y. Y. Luk, and R. Ho, "A review of literature on challenges in the development and implementation of generic competencies in higher education curriculum," *Int. J. Educ. Dev.*, vol. 57, pp. 1–10, 2017. https://doi.org/10.1016/j.ijedudev.2017.08.010

[76] D. Kember, D. Y. P. Leung, and R. S. F. Ma, "Characterizing learning environments capable of nurturing generic capabilities in higher education," *Res. High. Educ.*, vol. 48, no. 5, pp. 609–632, 2007. https://doi.org/10.1007/s11162-006-9037-0

[77] L. C. Montero, K. Galantini Velarde, A. Reátegui Arrué, and A. A. Del Savio, "Online learning environments for the promotion of undergraduate research in pandemic times: A case study in an engineering program," *J. Eng. Educ. Transform.*, vol. 36, no. 4, pp. 161–171, 2023. https://doi.org/10.16920/jeet/2023/v36i4/23126

[78] R. Hernández-Sampieri, C. Fernández-Collado, and P. Baptista-Lucio, *Metodología de la investigación*. México D.F.: McGraw-Hill, 2014.

[79] C. Wainerman, "En estado de tesis: cómo elaborar el proyecto de tesis en ciencias sociales," Manantial, Buenos Aires, 2020.

[80] E. O. Rocha and A. J. Dipp, "Escala de evaluación de competencias investigativas," *Praxis Investigativa ReDIE: Revista Electrónica De La Red Durango De Investigadores Educativos*, vol. 2, no. 3, pp. 72–75, 2010. Available: https://dialnet.unirioja.es/descarga/articulo/6534523.pdf

[81] M. Gonzales-Macavilca and M. Aguinaga-Villegas, "Panorama of Peruvian primary education teachers trained in ICT use before COVID-19 pandemic," in *2023 IEEE 3rd International Conference on Advanced Learning Technologies on Education & Research (ICALTER)*, Chiclayo, Peru, 2023, pp. 1–4. https://doi.org/10.1109/ICALTER61411.2023.10372904

[82] Ugaz, "Nivel percibido de competencias investigativas en estudiantes de la Escuela de Estomatología de la Universidad Señor de Sipán 2017," Universidad Señor de Sipán, 2017. https://hdl.handle.net/20.500.12802/4519

[83] F. Böttcher and F. Thiel, "Evaluating research-oriented teaching: A new instrument to assess university students' research competences," *Higher Education*, vol. 75, no. 1, pp. 91–110, 2017. https://doi.org/10.1007/s10734-017-0128-y

[84] J. C. Céspedes, L. M. Bermúdez, O. L. B. Matarrita, Y. R. Sánchez, and M. V. Sossa, "Competencias investigativas en el personal académico de la Escuela de Ciencias de la Educación de la UNED, Costa Rica," *UNED Research Journal*, vol. 4, no. 2, pp. 273–282, 2012. https://doi.org/10.22458/urj.v4i2.16

[85] L. S. Nowell, J. M. Norris, D. E. White, and N. J. Moules, "Thematic analysis: Striving to meet the trustworthiness criteria," *International Journal of Qualitative Methods*, vol. 16, no. 1, pp. 1–13, 2017. https://doi.org/10.1177/1609406917733847

[86] R. Quivy and L. y Van Carnpenhoudt, *Manual de investigación en ciencias sociales*. México D.F.: Limusa, 2005.

[87] J. Saldaña, *The Coding Manual for Qualitative Researchers*. Los Angeles, CA: Sage, 2009.

[88] D. B. de Campos, L. M. M. de Resende, and A. B. Fagundes, "The importance of soft skills for the engineering," *Creative Education*, vol. 11, pp. 1504–1520, 2020. https://doi.org/10.4236/ce.2020.118109

[89] M. Colburn, "An alternative to categorizing skills as soft or hard," *OD Practitioner*, vol. 50, no. 4, pp. 65–66, 2018. https://www.odnetwork.org/page/Publications

[90] J. L. Díaz and Y. Ordónez, "A classroom experience about the application of research-based learning for the teaching of probability in engineering," *STEM Education*, vol. 4, no. 2, pp. 127–141, 2024. https://doi.org/10.3934/steme.2024008

[91] C. Succi, "Are you ready to find a job? Ranking of a list of soft skills to enhance graduates' employability," *International Journal of Human Resource Development & Management*, vol. 19, pp. 281–297, 2019. https://doi.org/10.1504/IJHRDM.2019.100638

[92] J. Miyahira Arakaki, "La investigación formativa y la formación para la investigación en el pregrado," *Revista Médica Herediana*, vol. 20, no. 3, pp. 119–122, 2009. https://doi.org/10.20453/rmh.v20i3.1010

[93] D. Bowyer and M. Akpinar, "Experiences of academics and undergraduate students on research-based learning: A tale of two institutions," *Innovations in Education and Teaching International*, vol. 61, no. 1, pp. 45–56, 2022. https://doi.org/10.1080/14703297.2022.2149606

[94] A. R. Briones, E. G. Meza, S. A. D. Fritz, and D. A. Macias, "Innovación y competencias investigativas en universidades públicas," *Revista Venezolana De Gerencia*, vol. 29, no. 106, pp. 776–792, 2024. https://doi.org/10.52080/rvgluz.29.106.20

[95] J. I. Prado Juscamita, "Investigación formativa como estrategias de enseñanza-aprendizaje," *Human Review. International Humanities Review/Revista Internacional De Humanidades*, vol. 16, no. 3, pp. 1–9, 2023. https://dialnet.unirioja.es/servlet/articulo?codigo=8840075

[96] A. Mamdouh, M. Abdelkader, and T. Samir, “Analysis of the gap in architects’ skills of lifelong learning,” *Ain Shams Engineering Journal*, vol. 13, no. 6, p. 101805, 2022. https://doi.org/10.1016/j.asej.2022.101805

[97] N. Dawe, L. Romkey, A. Bilton, and K. Moozeh, “Identifying curriculum factors that facilitate lifelong learning in alumni career trajectories: Stage 1 of a sequential mixed-methods study,” in *2022 ASEE Annual Conference & Exposition*, Minneapolis, MN, 2024. https://doi.org/10.18260/1-2--41117

[98] E. Eppler-Hattab, “From lifelong learning to later life self-employment: A conceptual framework and an Israeli enterprise perspective,” *Journal of Enterprising Communities People and Places in the Global Economy*, vol. 16, no. 6, pp. 948–966, 2021. https://doi.org/10.1108/JEC-01-2021-0014

[99] O. Campos-Ugaz *et al.*, “Formative research to strengthen enquiry competence in university students,” *International Journal of Learning Teaching and Educational Research*, vol. 21, no. 11, pp. 443–464, 2022. https://doi.org/10.26803/ijlter.21.11.25

[100] A. L. Raine and M. Pandya, “Three keys to entrepreneurial success: Curiosity, creativity, and commitment,” *Entrepreneurship Education*, vol. 2, nos. 3–4, pp. 189–198, 2019. https://doi.org/10.1007/s41959-019-00019-y

[101] M. Jeraj, M. Marič, I. Todorović, M. Čudanov, and S. Komazec, “The role of openness and entrepreneurial curiosity in company’s growth,” *Amfiteatru Economic*, vol. 17, no. 38, pp. 371–389, 2015.

[102] I. F. Yarullin, N. A. Bushmeleva, and I. I. Tsyrkun, “The research competence development of students trained in mathematical direction,” *International Electronic Journal of Mathematics Education*, vol. 10, no. 3, pp. 137–146, 2015. https://doi.org/10.29333/iejme/296

[103] A. A. Del Savio, K. Galantini Velarde, B. Díaz-Garay, and E. Valcárcel Pollard, “A methodology for Embedding Building Information Modelling (BIM) in an undergraduate civil engineering program,” *Applied Sciences*, vol. 12, no. 23, p. 12203, 2022. https://doi.org/10.3390/app122312203

[104] D. B. Knight and B. J. Novoselich, “Curricular and cocurricular influences on undergraduate engineering student leadership,” *Journal of Engineering Education*, vol. 106, pp. 44–70, 2017. https://doi.org/10.1002/jee.20153

[105] J. Esquivel-Grados, V. Venegas-Mejía, C. P. Venegas-Mejía, M. T. Gonzáles-Benites, H. A. Valdivia-Huaranga, and N. B. Salazar, “Formative research: Perceptions of communication science students at a Peruvian university,” *Journal of Technology and Science Education*, vol. 13, no. 2, p. 565, 2023. https://doi.org/10.3926/jotse.1758

[106] M. Valderrama, C. Perez, G. Llaque, and J. Matute, “Investigative skills in university students. A systematic review,” in *Proceedings of the 20th LACCEI International Multi-Conference for Engineering, Education and Technology*, 2022. https://doi.org/10.18687/LACCEI2022.1.1.127

[107] J. I. Kino-Saravia, W. E. Vidaurre-García, J. M. Silva-Ravines, and H. L. Gonzales, “Herramientas tecnológicas y competencias investigativas en estudiantes universitarios,” *Revista Venezolana de Gerencia*, vol. 28, no. Especial 10, pp. 1610–1630, 2023. https://doi.org/10.52080/rvgluz.28.e10.45

[108] L. Briseño, “Los retos de la historia académica en la era digital,” *Historia y Memoria*, vol. 22, pp. 161–195, 2021. https://doi.org/10.19053/20275137.n22.2021.10907

[109] S. Tobón, *Metodología de gestión curricular. Una perspectiva socioformativa*. México D.F.: Trillas, 2013.

[110] F. Almeida and J. Morais, “Strategies for developing soft skills among higher engineering courses,” *Journal of Education*, vol. 203, no. 1, pp. 103–112, 2021. https://doi.org/10.1177/00220574211016417

[111] C. Corrales and L. Chumpitaz, "Investigative competencies of Industrial Engineering students. Exploratory study," in *Proceedings of the 21st LACCEI International Multi-Conference for Engineering, Education, and Technology*, 2023. https://doi.org/10.18687/LACCEI2023.1.1.1456

[112] J. Thiem, R. Preetz, and S. Haberstroh, "How research-based learning affects students' self-rated research competences: Evidence from a longitudinal study across disciplines," *Studies in Higher Education*, vol. 48, no. 7, pp. 1039–1051, 2023. https://doi.org/10.1080/03075079.2023.2181326

[113] M. Epiquién, O. J. O. Carrasco, J. D. F. Escobedo, and Y. A. S. Díaz, "Investigación formativa en el desarrollo de competencias investigativas en estudiantes universitarios," *Revista de Ciencias Sociales*, 2023. https://doi.org/10.31876/rcs.v29i4.41264

[114] A. M. Boelt, J. E. Holgaard, and A. Kolmos, "A thematic analysis of engineering students' experiences of teamwork in problem-based learning," Research Portal (King's College London), 2023. [Online]. Available: https://vbn.aau.dk/da/publications/37ffcdb4-2b8a-498e-8ab6-0f6b4b5170f9

[115] D. Zuo, M. Samuel, and S. Y. Tan, "Emerging engineering education in China: A systematic literature review," *Int. J. Eng. Ped.*, vol. 15, no. 2, pp. 153–164, 2025. https://doi.org/10.3991/ijep.v15i2.53627

[116] D. Khodadad, "Creating a supportive and effective learning environment for engineering students: Pedagogical strategies, engagement, and enhanced outcomes," *Int. J. Eng. Ped.*, vol. 13, no. 8, pp. 33–50, 2023. https://doi.org/10.3991/ijep.v13i8.41755

[117] C. De Pablos Heredero, S. Haider, and A. García Martinez, "Relational coordination as an indicator of teamwork quality: Potential application to the success of e-learning at universities," *Int. J. Emerg. Technol. Learn.*, vol. 10, no. 2, pp. 4–8, 2015. https://doi.org/10.3991/ijet.v10i2.4102

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