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Research Article

Global Competencies In Engineering through Interdisciplinarity and Experiential Learning. A Theoretical Approach

Pedro Arcia-Hernández[1], Reina Pérez-Vargas[2], Silvia Navarro-Sabin[3], Edith Carola Ubilla-Briones[4], Antony Paul Espíritu-Martínez[5], Johanna Solange Godoy-Cerda[6], Claudia Torres-Calvimonte[7], Galvarino Casanueva-Yánez[8]

[1]Universidad de Talca, Chile. ORCID: https://orcid.org/0000-0003-4472-7642 Correo: Arciapedro30@gmail.com
[2]César Vallejo University; reinita2perez@gmail.com
[3]Member of the Network of Scientific Researchers of Latin America and El Caribbean; sabinsilvia37@gmail.com
[4]Fundación Instituto Profesional Duoc UC, Santiago, Chile https://orcid.org/0000- 002-1134-8382 ed.ubilla@profesor.duoc.cl
[5]Universidad Nacional Autónoma Altoandina, Tarma, Perú
[6]Universidad Metropolitana de Ciencias de la Educación, Chile johanna.godoy2021@umce.cl https://Orcid.org/0009-0003-9500-4986
[7]claudiatorrescalvimontes@gmail.com LASA. Orcid.org/0000-0001-6520-5662 Santa Cruz de la Sierra
[8]Facultad de Ingeniería y Negocios Universidad de Las Américas, Sede Providencia, Manuel Montt 948, Santiago, Chile

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ABSTRACT

The work aims to study the integration of engineering education with various areas of knowledge to train professionals who address complex problems in a creative way, emphasizing experiential learning and interdisciplinarity to develop global competencies in the face of contemporary challenges. The scenario is represented by two Chilean universities and the critical knot consists of the need to redefine pedagogical approaches in the training of engineers to ensure that graduates not only possess technical knowledge, but are also equipped with global competencies that allow them to collaborate effectively in a diverse and constantly changing work environment. Two thematic axes are addressed : iinterdisciplinary e-education and e-experiential learning, both focused on the training of engineers in global competencies. The study is quantitative, with a non-experimental design, of a descriptive-transactional type. The population was made up of 29 students from engineering programs selected through probability sampling. A structured questionnaire validated by experts in the area was used. Among the results , a positive assessment of interdisciplinarity among students stands out, who relate it to better problem solving. It was concluded that the new theoretical approach that emerges in the context of university education, focuses on transforming engineering education towards a comprehensive and contextualized approach, considering interdisciplinarity as a primary conceptual framework and promoting collaboration between various areas of knowledge through the creation of academic programs that integrate subjects and projects from different disciplines.

Keywords: University education, engineering, interdisciplinarity, global competencies.

INTRODUCTION

Throughout history, engineering has evolved significantly, accompanying and often driving advances in human knowledge. From its beginnings in early civilizations to its current sophistication, engineering has been an essential driver of human development. In ancient times, early engineers employed basic principles of physics and geometry to build monuments, infrastructure, and irrigation systems that not only served their societies, but also revealed a growing mastery over the natural environment. The pyramids of Egypt, the canals of Mesopotamia, and Greek temples are early examples of how engineering began to be integrated into everyday life, facilitating a better quality of life and laying the foundation for social progress.

The Royal Spanish Academy (RAE) defines engineering as a "set of knowledge aimed at the invention and use of techniques for the use of natural resources or for industrial activity", and from this argument it follows as part of its ultimate purpose the action of simplifying human action, revolutionizing daily aspects and improving the quality of life. a phenomenon that has occurred since the beginning of civilization.

In this regard, Van der Laat (1991) argues that: "in the process of social and cultural evolution, throughout the history of humanity, man has generated transcendental changes at certain times that left a deep mark on current societies and were relevant in their transformation process, substantially altering the way of life existing at the time" (p. 71). Paraphrasing this, the author refers to human inventiveness with an engineering approach.

In addition to this, the review of specialized literature allows us to understand that over time engineering has been consolidated as a discipline that connects multiple areas of knowledge, especially in the Middle Ages, when, despite the slow expansion of knowledge in Europe, other regions such as the Arab world and Asia continued to develop technological innovations. Mills, hydraulic systems, and the first simple machines began to show how applied knowledge could transform production and the economy, anticipating future technical revolutions. However, the real paradigm shift in the evolution of engineering occurred during the Industrial Revolution, when mechanization, the introduction of the steam engine, and advances in mass production radically altered the way humanity produced, lived, and moved.

This period not only marked the birth of new branches of engineering, such as mechanics and electrical, but also showed how technology was beginning to be a central pillar in social transformation. As the twentieth century progressed, engineering not only diversified into multiple fields, but also became an essential vehicle for meeting the challenges of an increasingly interconnected and technology-dependent world. The emergence of disciplines such as computer science, aerospace engineering, and biotechnology reflected a broadening of the horizons of applied knowledge, where solving global problems, from climate change to energy sustainability, became a central part of engineering goals. This evolution, in tune with the different ages of knowledge, reveals how engineering has gone from being a practical activity focused on infrastructure to a transversal discipline that intervenes in all aspects of modern life.

This historical overview of engineering, seen through its development in the different eras of knowledge, offers a unique perspective on its transformative role in society. Engineering not only connects diverse sciences, but also has a direct impact on education, especially in the training of professionals trained to solve the complex problems of today's world.

From the above arguments, the need arises to answer two questions: (1) How does engineering, as a transversal discipline, influence the integration of knowledge from various sciences to address practical problems in everyday life and in sustainable development? and (2) What is the relevance of engineering education today?

In this way, the work is structured in three conceptual topics. The first seeks an approach to Interdisciplinary education as a comprehensive approach for the development of engineering competencies to address complex problems in a holistic and creative way in an interconnected world; the second topic, on the other hand, refers to experiential learning in the training of engineers, considering precisely experience as a strategic source for the Development of Global Competencies and the third thematic axis emphasizes interdisciplinarity and active learning as a binomial of integrated competence for experiential learning.

OBJECTIVE

To study the integration of engineering education with various areas of knowledge to train professionals who address complex problems in a creative way, emphasizing experiential learning and interdisciplinarity to develop global competencies in the face of contemporary challenges.

LITERATURE REVIEW

This research is framed in an educational context that demands a comprehensive training in engineering, capable of responding to the complex challenges of the contemporary world. Its relevance lies in the need to understand how the integration of various areas of knowledge can enrich the training of future engineers. Meanwhile, through an exhaustive review of bibliographies, it seeks to place the study in a solid conceptual framework that supports the importance of experiential learning and interdisciplinarity as key tools to develop global competencies.

In line with this, Guirao (2015) argues that: "Bibliographic review has been defined as "the documentary operation of retrieving a set of documents or bibliographic references that are published in the world on a topic, an author, a publication or a specific work" (n/n).

Interdisciplinary Education: A Comprehensive Approach to the Development of Engineering Competencies.

Disciplinarity in the context of education and research, in its classical and fragmentary status, describes theories, methodologies and concepts of a field of knowledge, thereby delimiting the epistemological, epistemological and theoretical boundaries of knowledge according to a scientific and/or social community that, presupposes within this field, meanings of universal and non-utilitarian cumulative truth to explain phenomena. Moreover, the authors agree

that the discipline refers to a specific field of knowledge or a branch of knowledge, with its own methods, theories and approaches, while disciplinarity refers to the structure and organization of knowledge within a single area or discipline, where studies and practices are developed in a concentrated and deep way in that particular field.
It is not necessary to confirm these conceptual aspects because they have abundant literature and representatives since "from the seventeenth century onwards, the vision of knowledge that still endures today, and which is known as "The Classical Paradigm of Science", was consolidated, step by step. This paradigm emerges progressively from the thought of three characters: Renato Descartes, in terms of the philosophical bases; Francisco Bacon in terms of the method and Isaac Newton, in terms of the realization and perfection of such a paradigm. (Hoyos, 2001, p. 4). Their contributions led to a taxonomy of sciences that were categorized as hard, pure, and natural and that over time have been based on the principle of specialization to specifically border their individuality in fields and areas of educational knowledge.
Hence, it is necessary to discuss the concept that transcends this individuality and that presupposes a claim of collaboration and integration between two or more disciplines, that is, interdisciplinarity as a node that summons this section in the educational context. For Llano et. Al, (2016): "interdisciplinarity is a process that refers to the connection of everything that exists" while Blanco et. Al (2011), assume it as "the concatenation of processes and phenomena, the diverse but unique" (...) Thus, for the authors of the work, interdisciplinarity seen from the academic point of view is a process based on the correlation between various disciplines that maintain their independence, but are linked in the projections for the achievement of prioritized teaching and educational objectives, the latter being the approach adopted to refer interdisciplinary education in the development of engineering competencies.
In this sense, fundamental competencies in engineering include technical, analytical, and problem-solving skills, along with transversal capabilities such as teamwork, critical thinking, and innovation. In a context of post-industrial societies and the digital age, interdisciplinary education is key, as it allows engineers to address complex problems from multiple approaches. This type of training is essential for professionals to be able to adapt to technological evolution and global challenges, integrating technical, social, ethical and environmental aspects into their work.
Universities in the 21st century must adjust their training plans so that graduates not only master specific knowledge, but are also able to collaborate in multidisciplinary environments and respond to the demand of the labor market. Interdisciplinarity fosters the ability of engineers to lead innovative projects and propose sustainable technological solutions, ensuring that their graduate profile is aligned with current challenges. This approach reinforces the role of universities as drivers of knowledge and innovation in a globalized world.

Experiential Learning in the Training of Engineers: Strategies for the Development of Global Competencies.

Experience, broadly speaking, refers to the set of knowledge, skills, and competencies acquired through practice and exposure to real-world situations over time. In the educational and professional context, experience enables people to effectively apply what they have learned theoretically, adapting to specific circumstances and improving their ability to solve problems and make decisions. In the case of people who are training in engineering, the experience of everyday life represents an extraordinary source of information that exposes them to interdisciplinary contexts, where they must integrate knowledge from different areas to address complex situations and that acquires methodological and engineering rigor when they intertwine it with their formal learning.
However, in a rapidly changing environment due to the level of progress achieved, in which the limits of knowledge in the different disciplines are being expanded every day through research, and where new advances are easily disseminated thanks to current information and communication technologies, it is logical that, as Ariza (2010) points out, "...the training needs and the professional profile required, necessary to perform satisfactorily in these circumstances, evolve" (p. 90); engineering disciplines are no exception.
In this context, there is currently no consolidated or widely accepted theoretical framework to explain experiential learning. Recently, some authors (Chisholm et. al., 2009, p. 320) have tried to establish a conceptual model in order to provide a theoretical basis for the systematic study of learning linked to the performance of professional tasks (workbased learning), understanding the latter as a form of experiential learning. One of the arguments put forward to justify the relevance of their work is the fact that, since individuals learn continuously outside formal contexts, as a result of their experience and interaction with the environment, the study of other types of learning that develop spontaneously in environments other than the classroom could make it possible to understand and take advantage of their formative potential. at the level of not only talking about conceptual, procedural and attitudinal competencies, but more of global competencies where collaboration, integrality, the holistic and the transcendental are a common denominator in the work of solving problems and situations.
Hence, in order to build over time and based on daily experience, engineers and those who are being trained in the profession must recover the sense of the concentric nature of learning by identifying not only what can be solved with what they learn, but also the pedagogical protocol with which they learn; that is, the development of global competencies in engineering students requires educational strategies that promote comprehensive learning and adaptation to multiple contexts without ignoring the weight of their own discipline.
In this sense, the development of global competencies in engineering students requires the implementation of

educational methodologies such as interdisciplinary learning, project-based learning and international mobility. According to De Wit (1995), the integration of diverse disciplines fosters students' ability to address complex problems from multiple approaches, while Kolb (2015) argues that experiential learning, through real projects in collaboration with industry, allows engineers to apply innovative and sustainable solutions. In addition, authors such as Knight (2004) highlight the importance of academic mobility and exchange programs, which provide students with a broader cultural understanding and allow them to face global challenges with a more adaptive and critical vision. These methodologies, combined with the use of emerging technologies, prepare engineers to perform effectively in globalized work environments.

From the postulates of the previous authors, the following concept of global competence in the engineering training context is inferred: students' ability to integrate knowledge from various disciplines, apply innovative and sustainable approaches to complex problems and adapt to a multicultural and dynamic work environment. This concept implies not only mastery of emerging tools and technologies, but also the ability to collaborate effectively in multidisciplinary and virtual teams, solve problems using data analysis and artificial intelligence, and communicate clearly in a global context. In this sense, engineering training is enriched by incorporating educational methodologies that promote experiential learning and international mobility, preparing future engineers to face contemporary challenges in an interconnected and constantly changing world.

METHODOLOGY

The methodological framework of this research is framed in the quantitative approach, whose purpose is to analyze the integration of engineering education with various areas of knowledge to develop global competencies in students. According to Sampieri et. al (2014), this approach "uses data collection to test hypotheses based on numerical measurement and statistical analysis, in order to establish behavioral patterns and test theories" (p. 4).

The research was based on a non-experimental, descriptive-transactional design, which allowed describing the variables involved, such as interdisciplinarity, experiential learning and the development of global competencies. The study population included 29 students from engineering programs at two Chilean universities, selected through probability sampling, ensuring adequate representation for subsequent statistical analyses.

A structured questionnaire was used to collect data that mediated two units of analysis: (1) influence of Engineering as a Transversal Discipline and (2) relevance of Engineering Education today. A questionnaire is, by definition, the standardized instrument that we use to collect data during the fieldwork of some quantitative research, fundamentally, those carried out with survey methodologies (Meneses, 2016, p. 10). This instrument was validated by experts in the area and a pilot test was carried out to adjust its reliability, which was 83%. The data obtained were analyzed using descriptive and inferential statistical techniques, with support in the descriptive percentage interpretation.

This methodological protocol allowed obtaining results that contributed to the understanding of how interdisciplinarity and experiential learning influence the training of engineers capable of facing contemporary challenges in a globalized and constantly changing environment.

RESULTS AND DISCUSSION

The most relevant results of the research are presented below. To this end, double-entry tables are presented that show data grouped by dimensions and indicators, respecting the structural rigor of the questionnaire.

Table 1. Interdisciplinarity dimension.

N°	Item	Alternatives											
		ADD		GIVES		N		ED		TED		Total	
		ago	%	ago	%	ago	%	ago	%	ago	%	ago	%
1	Do the subjects in your curriculum integrate knowledge from other disciplines (social sciences, natural sciences, etc.)?	10	34,5	9	31	5	17,2	3	10,3	2	6,9	29	100
2	Has the inclusion of interdisciplinary subjects in your training improved your ability to solve complex problems?	12	41,4	10	34,5	6	20,7	1	3,4	0	0	29	100

3	Are you satisfied with the number of interdisciplinary courses offered in your engineering program?	7	24,1	12	41,4	7	24,1	2	6,9	1	3,4	29	100
4	Are you comfortable applying natural science concepts (physics, chemistry, biology) in your engineering projects?	8	27,6	11	37,9	6	20,7	3	10,3	1	3,4	29	100
5	Is it important for you to master scientific concepts in your training as an engineer?	9	31	10	34,5	7	24,1	2	6,9	1	3,4	29	100
6	Do you receive sufficient training in scientific concepts relevant to your field of study?	12	41,4	8	27,6	6	20,7	2	6,9	1	3,4	29	100
			33,3		**34,5**		**21,3**		**7,5**		**4,4**		**100**

Source: Research database.

The analysis of the results related to the interdisciplinarity dimension reveals that a significant number of students recognize the integration of various disciplines in their training, which strengthens their ability to address complex problems. 34.5% of those surveyed say that their subjects integrate knowledge from other disciplines, such as social and natural sciences, and 41.4% consider that these interdisciplinary subjects have improved their ability to solve complex problems.

However, satisfaction with the number of interdisciplinary courses offered is mixed, with 24.1% neutral and 24.1% dissatisfied, suggesting that there is room for improvement in the offer of these courses. Regarding the application of natural science concepts in engineering projects, 37.9% of students feel comfortable with this practice, although a fifth are neutral. In addition, the majority of respondents consider it important to master scientific concepts, with 34.5% agreeing and 31% strongly agreeing, which reinforces the relevance of this knowledge in their training. However, 10.3% of students are not satisfied with the science training they receive, which indicates that some perceive shortcomings in this aspect.

The study shows a positive assessment of interdisciplinarity among students, who relate it to better problem solving. However, the need to expand the offer of interdisciplinary courses and strengthen science training was identified. These findings highlight the importance of interdisciplinarity in higher education and suggest areas for improvement in curricula.

Table 2. Integrated knowledge.

No.	Item	Alternatives											
		TDA		**ALSO**		**N**		**AND**		**TED**		**Total**	
		ago	%	ago	%	ago	%	ago	%	ago	%	ago	%
7	Are you comfortable applying natural science concepts (physics, chemistry, biology) in your engineering projects?	11	37,9	8	27,6	6	20,7	3	10,3	1	3,4	29	100
8	Is it important for you to master scientific concepts in your training as an engineer?	14	48,3	9	31	5	17,2	1	3,4	0	0	29	100
9	Do you receive sufficient training in scientific concepts relevant to your field of study?	10	34,5	10	34,5	6	20,7	2	6,9	1	3,4	29	100

10	Are you comfortable applying natural science concepts (physics, chemistry, biology) in your engineering projects?	12	41,4	11	37,9	4	13,8	1	3,4	1	3,4	29	100
11	Is it important for you to master scientific concepts in your training as an engineer?	9	31	10	34,5	7	24,1	2	6,9	1	3,4	29	100
12	Do you receive sufficient training in scientific concepts relevant to your field of study?	13	44,8	8	27,6	5	17,2	2	6,9	1	3,4	29	100
			39,7		**32,2**		**19,0**		**6,3**		**2,8**		**100**

Source: Research database.

The above table shows a positive assessment of the integration of scientific knowledge in the training of engineers. Most students consider it important to master scientific concepts and recognize their usefulness in solving complex problems. However, although most feel comfortable applying these concepts, there is a percentage that is not completely satisfied with the training received. This indicates the need to strengthen basic science teaching and provide more opportunities to apply knowledge in practical contexts. The results emphasize the importance of interdisciplinarity in engineering, as it allows students to develop a more holistic view of problems and find innovative solutions.

Table 3. Application of scientific theories in projects.

No.	**Item**	**Alternatives**											
		TDA		**ALSO**		**N**		**AND**		**TED**		**Total**	
		ago	%	ago	%	ago	%	ago	%	ago	%	ago	%
13	Have you tackled practical problems using an interdisciplinary approach?	10	34,5	9	31	5	17,2	3	10,3	2	6,9	29	100
14	Would you rate your ability to solve complex problems that require knowledge from different disciplines?	12	41,4	10	34,5	6	20,7	1	3,4	0	0	29	100
15	Has your engineering background adequately prepared you to solve problems in everyday life?	7	24,1	12	41,4	7	24,1	2	6,9	1	3,4	29	100
16	Have you analyzed case studies that address real problems during your engineering training?	8	27,6	11	37,9	6	20,7	3	10,3	1	3,4	29	100
17	Are case studies useful for learning how to apply their knowledge?	9	31	10	34,5	7	24,1	2	6,9	1	3,4	29	100
18	Has the evaluation of case studies influenced your ability to tackle practical problems?	11	37,9	8	27,6	6	20,7	2	6,9	2	6,8	29	100
			32,8		**34,5**		**21,3**		**7,5**		**4,0**		**100**

Source: Research database.

The table shows an analysis of the perception of engineering students regarding the application of scientific theories in projects and their preparation to tackle practical problems. Overall, there is a trend towards dissatisfaction, with 34.5% of respondents having tackled problems using an interdisciplinary approach and 41.4% feeling capable of solving complex problems; However, a significant number disagree, indicating that many do not consider that they have sufficiently used an interdisciplinary approach or that their training adequately prepares them to solve everyday problems. In addition, although 37.9% maintain that the case studies have positively influenced their ability to solve practical problems, the perception of their usefulness is quite divided, with 34.5% who do not find them effective. These results suggest that educational institutions should rethink their curriculum to integrate more interdisciplinary approaches and relevant case studies, which could improve students' practical training and better prepare them for real-life and professional challenges.

This finding aligns with the theory of learning transfer, which holds that knowledge acquired in academic contexts must be applicable to real-world situations to be truly effective; Therefore, the lack of connection between theory and practice in engineering education could be limiting students' ability to apply their learning in concrete scenarios.

Table 4. Labor Demand.

No.	Item	Alternatives											
		TDA		ALSO		N		AND		TED		Total	
		ago	%	ago	%	ago	%	ago	%	ago	%	ago	%
19	How easy has it been to find employment opportunities in the engineering field since you graduated?	8	27,6	10	34,5	7	24,1	2	6,9	2	6,9	29	100
20	Do you think that engineering training is aligned with the current needs of the labor market?	14	48,3	8	27,6	5	17,2	2	6,9	0	0	29	100
21	Are there enough job opportunities for engineering graduates in your country?	10	34,5	11	37,9	4	13,8	3	10,3	1	3,4	29	100
			36,8		**33,3**		**18,4**		**8,0**		**3,4**		**100**

Source: Research database.

The table presents an analysis of the perception of engineering graduates regarding the labor demand and their preparation to face the labor market. In general, there is a trend towards concern, as only 27.6% of respondents consider that it has been easy to find employment opportunities since graduation, while 34.5% disagree with this statement, which indicates that a significant part of graduates face difficulties in their job placement. Regarding the alignment of training with the needs of the market, 48.3% believe that their education is well adapted, but 27.6% still have doubts about this issue, suggesting that there is a perception of disconnection between education. received and the expectations of the labor market. In addition, when asked if there are enough job opportunities, 34.5% answered positively, but 37.9% disagreed, evidencing a perception of a scarcity of opportunities in their country. These results suggest that educational institutions should reevaluate their programs to ensure that engineering training is aligned with the demands of the labor market and foster a greater connection between theory and practice.

This finding supports the human capital theory, which postulates that adequate education and training increase employability and job opportunities; Therefore, if graduates feel that their training does not meet the needs of the market, this could be limiting their ability to find opportunities.

Table 5. Industrial sectors that require engineers.

No.	Item	Alternatives											
		TDA		ALSO		N		AND		TED		Total	
		ago	%	ago	%	ago	%	ago	%	ago	%	ago	%
22	To what extent have you noticed demand for	12	41,4	9	31	5	17,2	2	6,9	1	3,4	29	100

	engineers in your specific industry sector?												
23	Do you think engineering education should focus more on certain industry sectors?	8	27,6	11	37,9	6	20,7	3	10,3	1	6,9	29	100
24	How relevant do you consider the skills acquired in your training for the sector in which you currently work?	10	34,5	10	34,5	6	20,7	2	6,9	1	3,4	29	100
			34,5		**34,5**		**19,5**		**8,0**		**3,4**		**100**

Source: Research database.

The above illustration shows an analysis of the perception of engineering graduates regarding the demand for engineers in specific industrial sectors and the relevance of their training. Overall, it is observed that 41.4% of respondents have noticed a significant demand for engineers in their industrial sector, while 31% express disagreement with this statement, suggesting that the perception of demand varies among graduates. and it could depend on the sector in which they are located. As for whether engineering education should focus more on certain industrial sectors, 37.9% disagree, which could indicate that the majority do not see the need for a change in the curricular approach; However, 27.6% believe that there should be a greater emphasis, suggesting that there is scope to tailor training to specific market needs. In addition, in relation to the relevance of the skills acquired during their training, 34.5% consider that they are adequate, although another 34.5% are not sure of their applicability in their current sector, which reveals a divided perception of the preparation received. These results suggest that educational institutions should evaluate the relevance of their curriculum according to the demands of industrial sectors and encourage a more specific focus on areas where a growing need is detected.

This result focuses on the theory of market adequacy, which argues that relevant education aligned with the demands of the sector improves the employability of graduates; Therefore, if engineers feel that their training does not fit the needs of their sectors, this could affect their professional performance and satisfaction in their current roles.

Table 6. Global competencies.

No.	Item	Alternatives											
		TDA		ALSO		N		AND		TED		Total	
		ago	%	ago	%	ago	%	ago	%	ago	%	ago	%
25	How would you rate your ability to work in a team with people from different cultures?	10	34,5	9	31	6	20,7	3	10,3	1	3,4	29	100
26	Have you received specific training in intercultural communication during your career?	8	27,6	10	34,5	7	24,1	2	6,9	2	6,9	29	100
27	Do you think engineering education has prepared you to face challenges in a global work environment?	12	41,4	10	34,5	5	17,2	2	6,9	0	0	29	100
			34,5		**33,3**		**20,7**		**8,0**		**33,4**		**100**

Source: Research database.

In relation to the dimension of global competencies, the table reflects the perception of engineering graduates, especially with regard to working in multicultural teams and the preparation to face challenges in a global work environment. In terms of intercultural collaboration, 34.5% of respondents rate their ability to work in a team with people from different cultures in a positive way, while 31% disagree, suggesting that there is a divided perception of this competence, which could imply the need for a greater focus on the development of intercultural skills in training

programs.
Regarding specific training in intercultural communication, only 27.6% have received training, while 34.5% express disagreement, indicating that a significant part of graduates do not consider themselves to have had sufficient training in this critical area. for success in an increasingly globalized work environment. In addition, when assessing whether engineering education has prepared them to face challenges in a global work environment, 41.4% feel positively prepared, although 34.5% have doubts about this statement, suggesting that, although there is confidence in the training received, concerns persist about the effectiveness of preparation for a diversified and multicultural work environment.

CONCLUSIONS

Interdisciplinary learning has become an essential focus in higher education, as it allows students to integrate knowledge and skills from various disciplines, favoring the development of global competencies necessary in an increasingly interconnected world.
The interrelationship between engineering and other areas of knowledge is fundamental, as it promotes a holistic vision that not only enhances innovation, but also responds to the complex challenges faced by today's society.
In this context, universities have a responsibility to prepare their students for the job market, encouraging an approach that transcends the traditional boundaries of disciplines. By doing so, graduates will not only be better equipped to meet the demands of the professional world, but will also contribute significantly to the advancement of society, integrating different perspectives and solutions to the problem.
In light of the results of the study, global competencies in engineering refer to a set of skills, knowledge and attitudes that allow engineers to work successfully in an international and multicultural context, contributing significantly to the construction of a transcendental engineering profile, which goes beyond the mere application of technical knowledge. This profile is characterized by the ability of engineers to positively impact society, the economy and the environment with an emerging approach to sustainability.
Finally, the new theoretical approach that emerges in the context of university education focuses on transforming engineering education towards a comprehensive and contextualized approach. This approach establishes interdisciplinarity as a central conceptual framework, promoting collaboration between various areas of knowledge and the creation of academic programs that integrate subjects and projects from different disciplines.
In turn, experiential learning is defined as the fundamental educational pillar, allowing students to apply concepts in real situations and develop soft skills such as adaptability and teamwork. The combination of these elements fosters a comprehensive development of global competencies, to share not only technical skills, but also intercultural communication, critical thinking and professional ethics.
This approach also emphasizes ethics, social responsibility and the formation of global citizens, fostering a commitment to society and the environment. It also incorporates the importance of technology and digital learning, where students are required to be proficient in technological tools and capable of critically evaluating information. Finally, it advocates the implementation of continuous assessment systems that include constructive feedback, promoting a culture of continuous improvement and reflective learning that allows students to identify their strengths and areas autonomously.

ANNEX A
Variable System

Objective	Unit of analysis	Variable	Indicator	Item
	Influence of Engineering as a Transversal Discipline	Inter-disciplinarity	Number of interdisciplinary subjects in the curriculum	1, 2 and 3
			Projects that integrate multiple disciplines	4,5, and 6
		Integrated insights	Students' understanding of scientific concepts	7, 8 and 9
			Application of scientific theories in projects	10, 11 and 12
		Application of scientific theories in projects	Examples of Problems Solved Interdisciplinarily	13, 14 and 15
			Practical Problem Solving	16, 17

			and 18
Relevance of Engineering Education Today	Labor Demand	Need for engineers in today's job market	19, 20 and 21
	Industrial sectors that require engineers	Industry Sectors	22, 23 and 24
	Global Competencies	Assessment of competencies such as teamwork and intercultural communication	25, 26 and 27

Note: Own elaboration (2024).

ANNEX B
Data collection instrument

1 (Strongly Disagree), 2 (Disagree), 3 (Neutral), 4 (Agree), 5 (Strongly Agree).
Unit of analysis: Influence of Engineering as a Discipline

N°	**Unit of analysis:** Influence of Engineering as a Transversal Discipline					
	Dimension: Interdisciplinarity					
	Indicator: Number of interdisciplinary subjects in the curriculum					
	Item	**Alternatives**				
		ADD	**GIVES**	**N**	**ED**	**TED**
1	Do the subjects in your curriculum integrate knowledge from other disciplines (social sciences, natural sciences, etc.)?					
2	Has the inclusion of interdisciplinary subjects in your training improved your ability to solve complex problems?					
3	Are you satisfied with the number of interdisciplinary courses offered in your engineering program?					
N°	**Indicator: Projects** that integrate multiple disciplines					
	Item	**Alternatives**				
		ADD	**GIVES**	**N**	**ED**	**TED**
4	Have you been involved in projects that involve collaboration with students from other disciplines?					
5	Have interdisciplinary projects contributed to your learning and understanding of engineering?					
6	Is collaboration with other disciplines essential for success in an engineering career?					
N°	**Mission:** Integrated Insights					
	Indicator: Students' understanding of scientific concepts					
	Item	**Alternatives**				
		ADD	**GIVES**	**N**	**ED**	**TED**
7	Are you comfortable applying natural science concepts (physics, chemistry, biology) in your engineering projects?					
8	Is it important for you to master scientific concepts in your training as an engineer?					
9	Do you receive sufficient training in scientific concepts relevant to your field of study?					
N°	**Indicator:** Application of scientific theories in projects					

	Item	Alternatives				
		ADD	GIVES	N	ED	TED
10	Are the scientific theories you've learned applicable in your practical work as an engineer?					
11	Have you applied specific scientific theories in your engineering projects?					
12	Has your ability to apply scientific theories improved over the course of your career?					
N°	**Dimension:** Application of scientific theories in projects					
	Indicator: Examples of problems solved interdisciplinarily					
	Item	**Alternatives**				
		ADD	**GIVES**	**N**	**ED**	**TED**
13	Have you tackled practical problems using an interdisciplinary approach?					
14	Would you rate your ability to solve complex problems that require knowledge from different disciplines?					
15	Has your engineering background adequately prepared you to solve problems in everyday life?					
N°	**Indicator:** Evaluation of applied case studies					
	Item	**Alternatives**				
		ADD	**GIVES**	**N**	**ED**	**TED**
16	Have you analyzed case studies that address real problems during your engineering training?					
17	Are case studies useful for learning how to apply their knowledge?					
18	Has the evaluation of case studies influenced your ability to tackle practical problems?					
	Unit of analysis: Relevance of Engineering Education today					
	Dimension: Labor Demand					
	Indicator: Need for engineers in today's labor market					
N°	**Item**	**Alternatives**				
		ADD	**GIVES**	**N**	**ED**	**TED**
19	How easy has it been to find employment opportunities in the engineering field since you graduated?					
20	Do you think that engineering training is aligned with the current needs of the labor market?					
21	Are there enough job opportunities for engineering graduates in your country?					
N°	**Dimension:** Industrial sectors that require engineers					
	Indicator: Industrial sectors					
	Item	**Alternatives**				
		ADD	**GIVES**	**N**	**ED**	**TED**
22	To what extent have you noticed demand for engineers in your specific industry sector?					
23	Do you think engineering education should focus more on certain industry sectors?					
24	How relevant do you consider the skills acquired in your training for the sector in which you currently work?					
N°	**Dimension:** Global Competencies					

	Indicator: Assessment of competencies such as teamwork and intercultural communication					
	Item	**Alternatives**				
		ADD	**GI V ES**	**N**	**ED**	**TED**
25	How would you rate your ability to work in a team with people from different cultures?					
26	Have you received specific training in intercultural communication during your career?					
27	Do you think engineering education has prepared you to face challenges in a global work environment?					

ANNEX C
Confidence Level

Subject	**1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29**
	It's 1: [4, 3, 5, 2, 3, 4, 3, 4, 5, 3, 4, 5, 3, 4, 3, 5, 2, 3, 5, 4, 3, 5, 4, 3, 1, 2, 4, 3, 1], Item 2: [5, 4, 2, 3, 5, 5, 2, 3, 4, 4, 2, 4, 3, 5, 3, 2, 5, 4, 2, 5, 5, 4, 3, 3, 2, 5, 3, 3], It's 3: [3, 4, 1, 5, 3, 3, 5, 2, 3, 5, 4, 5, 5, 5, 2, 5, 5, 1, 4, 4, 3, 3, 2, 5, 5, 4, 4, 5, 5], It's 4: [5, 3, 5, 2, 4, 2, 4, 5, 1, 4, 3, 4, 5, 3, 3, 5, 2, 2, 2, 3, 5, 5, 5, 3, 3, 3, 3, 3], It's 5: [4, 2, 3, 5, 2, 5, 1, 1, 2, 3, 5, 4, 3, 4, 5, 2, 4, 5, 2, 2, 4, 1, 2, 4, 4, 4, 4, 4, 4], It's 6: [2, 3, 4, 3, 4, 1, 5, 5, 5, 2, 4, 3, 4, 3, 4, 1, 5, 3, 4, 5, 3, 4, 5, 5, 2, 2, 4, 4, 2], It's 7: [1, 4, 2, 4, 5, 3, 4, 2, 4, 5, 2, 5, 3, 3, 5, 3, 5, 4, 5, 4, 3, 5, 3, 4, 1, 1, 2, 5, 2], It's 8: [3, 5, 1, 2, 3, 4, 2, 4, 3, 5, 4, 4, 4, 3, 5, 4, 5, 2, 3, 3, 4, 5, 4, 5, 4, 3, 2, 4], It's 9: [4, 2, 4, 4, 3, 4, 2, 4, 5, 5, 4, 2, 5, 2, 3, 2, 1, 2, 3, 4, 3, 4, 3, 2, 4, 3, 3, 5, 5], It's 10: [5, 3, 2, 4, 3, 5, 3, 3, 3, 3, 5, 5, 4, 2, 2, 4, 5, 5, 5, 4, 5, 4, 4, 3, 5, 4, 5, 4], It's 11: [3, 5, 3, 2, 5, 2, 2, 4, 3, 2, 5, 4, 5, 2, 2, 4, 4, 4, 2, 4, 4, 2, 2, 3, 5, 2, 5, 3], It's 12: [2, 4, 5, 5, 4, 4, 5, 5, 5, 5, 3, 4, 4, 2, 3, 2, 2, 3, 5, 3, 5, 5, 5, 4, 4, 3, 3], It's 13: [5, 3, 4, 3, 2, 2, 3, 4, 5, 5, 4, 3, 3, 5, 4, 4, 4, 4, 4, 5, 3, 3, 4, 5, 2, 5, 5, 5], It's 14: [4, 5, 5, 5, 3, 5, 5, 2, 4, 3, 3, 4, 3, 4, 3, 2, 5, 2, 4, 5, 3, 5, 2, 3, 4, 5, 4, 4], It's 15: [3, 4, 2, 4, 5, 4, 5, 2, 2, 5, 5, 5, 3, 5, 2, 3, 5, 4, 3, 3, 4, 4, 4, 4, 4, 5, 3, 2], It's 16: [5, 3, 3, 2, 4, 5, 2, 3, 4, 2, 5, 2, 4, 5, 5, 2, 4, 5, 5, 4, 4, 4, 4, 5, 3, 3, 2, 2, 4], It's 17: [3, 4, 5, 4, 3, 3, 2, 4, 5, 4, 2, 3, 5, 3, 5, 2, 5, 3, 2, 4, 4, 3, 3, 4, 3, 4, 5, 3], It's 18: [2, 2, 4, 5, 4, 4, 4, 4, 2, 3, 4, 3, 5, 4, 5, 2, 5, 3, 5, 2, 3, 4, 4, 4, 5, 2, 3, 2], It's 19: [3, 5, 5, 2, 3, 2, 3, 4, 5, 2, 4, 5, 4, 4, 3, 2, 3, 2, 4, 2, 5, 4, 4, 2, 2, 4, 4], It's 20: [4, 2, 5, 2, 4, 4, 5, 4, 5, 3, 2, 2, 2, 5, 2, 4, 4, 5, 4, 5, 4, 5, 4, 5, 3, 5, 5, 4, 4], It's 21: [2, 3, 4, 5, 4, 4, 5, 3, 4, 2, 2, 5, 5, 3, 4, 3, 2, 2, 2, 4, 5, 5, 3, 4, 4, 3, 2, 2], It's 22: [4, 2, 3, 5, 2, 5, 1, 1, 2, 3, 5, 4, 3, 4, 5, 2, 4, 5, 2, 2, 4, 1, 2, 4, 4, 4, 4, 4, 4], It's 23: [2, 3, 4, 3, 4, 1, 5, 5, 5, 2, 4, 3, 4, 3, 4, 1, 5, 3, 4, 5, 3, 4, 5, 5, 2, 2, 4, 4, 2], Verse 24: [1, 4, 2, 4, 5, 3, 4, 2, 4, 5, 2, 5, 3, 3, 3, 5, 5, 4, 5, 4, 3, 5, 3, 4, 1, 1, 2, 5, 2], It's 25: [3, 5, 1, 2, 3, 4, 2, 4, 3, 5, 4, 4, 4, 3, 5, 4, 5, 2, 3, 3, 4, 5, 4, 5, 4, 3, 2, 4], It's 26: [4, 2, 3, 5, 2, 5, 1, 2, 3, 5, 4, 3, 4, 5, 2, 4, 5, 2, 4, 1, 2, 4, 4, 4, 4, 4, 4, 4], It's 27: [2, 3, 4, 5, 4, 4, 5, 3, 4, 2, 2, 5, 5, 3, 4, 3, 2, 2, 2, 4, 5, 5, 3, 4, 4, 3, 2, 2],

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