Online-Journals.org

iJEP International Journal of Engineering Pedagogy

iJEP | eISSN: 2192-4880 | Vol. 15 No. 4 (2025) | OPEN ACCESS

https://doi.org/10.3991/ijep.v15i4.50987

PAPER

The Engineer as a Teacher: Professional Teaching Identity of Engineers in Spain

Claudia Carrasco-Aguilar[1,2](✉), Sebastián Ortiz-Mallegas[1], Mariano Martín-Civantos[3], Antonio Luzón[3]

[1]Universidad de Playa Ancha, Valparaíso, Chile

[2]Universidad de Málaga, Málaga, Spain

[3]Universidad de Granada, Granada, Spain

claudia.carrasco@upla.cl

ABSTRACT

The professional teaching identity of engineers who teach has been scarcely studied. This study employed a narrative approach to analyze the teaching identity of 17 engineers across three groups: those who train future engineers, those who prepare future science, technology, engineering, and mathematics (STEM) teachers, and those who are training to become STEM educators. Three dimensions of teaching identity were examined: personal, professional, and situational. Findings indicate that university professors construct their identity based on their personal trajectories, whereas future STEM educators emphasize their individual characteristics as key to their performance. Additionally, engineers who teach recognize the need for specific pedagogical training, yet they often rely on peer learning due to limited institutional support. Moreover, among those training to become teachers, professional experience in engineering is valued more highly than teaching practice. These results highlight the significance of context, career trajectory, and institutional support in shaping the teaching identity of engineers.

KEYWORDS

teaching identity, engineers, science, technology, engineering, and mathematics (STEM) education, university teaching, professional training

1 INTRODUCTION

Being an engineer and committing to teaching can bring different challenges [1]. In the case of higher education, university teaching often implies that the professor must become a role model, and in doing so, they must teach relevant issues such as ethics and awareness of the social impact of the discipline [2]–[6]. Likewise, as different teaching innovations are implemented, university professors have faced changes in how they conduct classes, having to develop new identities and ways of teaching engineering [7], [8]. In the same vein, changes in engineering education have been so significant in recent years that what had been uncommon in this field has become common and very relevant because either engineering is facing

Carrasco-Aguilar, C., Ortiz-Mallegas, S., Martín-Civantos, M., Luzón, A. (2025). The Engineer as a Teacher: Professional Teaching Identity of Engineers in Spain. *International Journal of Engineering Pedagogy (iJEP)*, 15(4), pp. 110–126. https://doi.org/10.3991/ijep.v15i4.50987

Article submitted 2024-07-08. Revision uploaded 2025-03-09. Final acceptance 2025-03-09.

accelerated changes or the profile of university students has evolved as times have changed [9]. This is the case with classroom climate, student emotions, and the interaction between professors and students [10]–[13]. This new scenario has forced university professors who are engineers to receive constant training to respond to new demands, needs, and realities [14], promoting more dialogic and participatory approaches to knowledge construction in the university engineering classroom [15].

On the other hand, another group of engineers has dedicated themselves to teaching. These are engineers who, for various reasons, have chosen to become professors in the technological education system [1]. Teachers in the area of science, technology, engineering, and mathematics (STEM) differ based on whether they have a technological or engineering background because teachers with different initial training have different perceptions of what students need to learn based on different circumstances or innovations [16]. Nonetheless, and beyond the initial training of teachers, numerous studies have shown the impact of high self-efficacy, mastery, and positive attitudes toward teaching STEM in secondary education [17], [18]. In this regard, the literature has abundant evidence that children learn more and better about STEM if they start participating at a young age in learning opportunities as similar as possible to those used by scientists and engineers [19], [20]. Pre-university education significantly shapes engineering interest, with social stereotypes often discouraging women and minorities from pursuing it in university [21], [22].

Gender is a central aspect in the education of engineers and STEM teachers because societal norms and gender stereotypes, ingrained from early childhood, often discourage participation of women, perpetuating their underrepresentation in these fields [23]–[25]. Despite achieving higher academic qualifications and engaging more in research, women frequently underestimate their scientific abilities [26]. In the field of computer science, this inequality is evident in both educational content and the low representation of women in academic and professional settings, with a sustained decline in their participation over time [27]. Textbooks reinforce gender stereotypes by presenting a male-centric view of technology, limiting female students' aspirations, and perpetuating their exclusion [28]. Recent research highlighted that women who integrate both feminine and masculine traits better positioned to connect with engineering. However, the cultural dynamics in the field continue to privilege masculine attributes, underscoring the need for inclusive policies that embrace diverse identities and skills [25].

The international literature has focused on analyzing pedagogical practices or teaching and learning methodologies that are effective for teaching engineering at universities and STEM in secondary education, highlighting characteristics that the teachers in both cases should possess. Thus, current research has mostly emphasized students and their future. However, few studies have considered the figure of the teacher beyond suggestions about necessary training, interactions with students, and role as motivators to learn STEM [29], [30].

Therefore, this study investigated the identity of engineers who work as teachers. Engineering has its own philosophy and identity, which cannot be equated with that of STEM's identity. Engineering has its own conceptualization, specific relationship with STEM, nature of knowledge and the justification of such knowledge, means with particular adequacy and justification, and status for the design of actions and relevant ethical aspects related to the profession [2], [4], [31]. Therefore, it is plausible to think that it also has its own teaching nature and identity. This study analyzed the construction of professional teaching identity among engineers who teach at universities and engineers training to become STEM educators in secondary education, considering the personal, professional, and situational dimensions of identity.

2 PROFESSIONAL TEACHING IDENTITY

Professional teaching identity is a widely debated construct with multiple definitions and approaches in the international literature. These approaches have highlighted how cultural and political contexts affect teaching practice, leading teachers to construct and negotiate their identity in response to these factors [32]. In this regard, professional teaching identity must be analyzed in interaction with sociohistorical contexts and mechanisms of social reproduction and transformation, emphasizing aspects such as leadership and transformative capacity [33]. Therefore, the international literature has historically analyzed the reflective role of teachers and how this strengthens their professional identity [34], [35].

Currently, research has reached a certain consensus on how to define teaching identity. Meanings and experiences related to the teaching profession, including teaching and learning, have been prioritized [36]. Therefore, teaching identity has been defined as the set of changing experiences of being, becoming, and belonging in relation to the profession [37]–[39], reflecting the representations that teachers have about their roles, teaching and assessment strategies and feelings about their professional practice [40]. In this regard, researchers have maintained the basic assumptions of the theoretical tradition on the subject, highlighting that professional teaching identity is affected by personal characteristics, past experiences, and professional contexts; interactions with significant individuals, knowledge, and experiences; and motivational, cultural, and normative aspects throughout their careers [41].

Accordingly, there is a tradition of investigating this construct through personal, professional, and situational dimensions. The first domain is related with life experiences that combine aspects of family, friends, and a sense of life transcendence. The second is defined as a relatively stable social construction framed in certain professional models based on teachers' interpretations of their work experiences. The third refers to the work context, in which identity develops [42], [43].

Regarding the professional teaching identity of university professors, specific tensions often help explain this identity and are related to the link between practical teaching and educational research and innovation [44], [45]. These tensions combine with factors such as job competition, professional motivation, career perspectives, and work achievements. Along with the lack of institutional support, they have led some researchers to conclude that more organizational efforts are needed to start properly discussing a "university pedagogy" as a field of teaching development [46].

On the other hand, the professional identity of future teachers is a continuous and changing process [47]–[49]. Specifically, regarding the identity of STEM teachers, perceived role and professional commitment stand out as determinants of the possibilities of trust in collective work, whereas perceived and designated roles affect the prescriptions they associate with their teaching functions [50], [51].

3 METHODOLOGY

This qualitative study relied on a biographical narrative approach. This type of study focuses on people's life experiences based on significant events, providing a deep understanding of their identity, values, and social and cultural contexts [52], [53]. In education, numerous studies have used this approach in recent years [54], [55], many of which have focused on teaching identity [56]–[58].

To select the study group, different sampling strategies were combined, following relevant guidelines [59]. First, open sampling was conducted by selecting

three professors from an engineering faculty at a public university in Southern Spain. Subsequently, relational-fluctuating sampling was used with four new university engineering professors. Three of them belonged to the same university, and the fourth worked at another university. Among them was the director of an engineering school. One professor was training future secondary school teachers in a master's degree program in secondary education teaching, who put us in contact with five new university engineering professors. Finally, the study concluded with discriminative sampling of four engineering students from the master's program and a professional tutor also an engineer, who worked at a practice school. In total, 17 engineers participated, organized into three groups: (a) engineers who train engineers, (b) engineers who train future STEM teachers, and (c) engineers who are future STEM teachers. Table 1 shows the characteristics of the study group.

Table 1. Characteristics of the study group

	Sex	Age	Type of Engineer (Profession)	Role		
				Educator of Prospective Engineers	Educator of Prospective Teachers	Prospective Teacher
1	F	50–60	Construction	X		
2	M	60–65	Construction	X		
3	F	40–50	Construction	X		
4	M	50–60	Construction	X		
5	F	50–60	Construction	X		
6	F	50–60	Construction	X		
7	M	50–60	Industrial		X	
8	M	40–50	Computer		X	
9	M	50–60	Industrial		X	
10	M	40–50	Computer		X	
11	F	40–50	Industrial		X	
12	M	40–50	Industrial		X	
13	M	20–30	Computer			X
14	F	20–30	Computer			X
15	F	30–40	Telecommunications			X
16	F	40–50	Telecommunications			X
17	M	50–60	Computer	Practicum Tutor, School Teacher		

Each participant completed an unstructured narrative interview [60], which covered their academic and training trajectory to the present. Transversally, the dimensions of professional teaching identity—personal, professional, and situational—were deepened based on their personal and professional experiences. Although the topics addressed the three dimensions of teaching identity, each question was posed in a particular way with each interviewee. Each interviewee participated voluntarily and was informed that they could withdraw at any time. Their personal data remain anonymous, as do the universities where they work.

This paper is framed by two research projects that have received authorization from an ethics committee on research 3310/CEIH/2023 and 2414/CEIH/2021.

Finally, the analysis procedure followed relevant recommendations [61] regarding thematic analysis for narrative research. This type of analysis focuses on identifying and interpreting patterns of meaning in narrative data through a systematic process of coding and categorization. This procedure allowed for the unraveling of predominant themes in the narratives and exploration of variations and complexities in the narrative data. First, the results of the emerging categorization were organized based on the dimensions of teaching identity—personal, professional, and situational—and then combined into a common narrative that accounted for the experience of the three groups of interviewees.

4 RESULTS

The following results show the analysis for each dimension, specifying the group to which the analyses corresponded. To provide evidence of the findings, direct quotes from the interviews are included.

4.1 Personal dimension

First, in the case of engineers who trained future engineers, the personal aspects of teaching identity were evident on two levels: (a) in the motivations and circumstances that led them to start university teaching and (b) in the deep meanings related to the training of future professionals.

Regarding the first point, access to university is often perceived as entering a workplace—that is, a professional setting similar to any other. However, over time, specific aspects of academic work become apparent, leading individuals to confront their personal life experiences in relation to their professional roles. In this process, personal characteristics and family history emerge as central elements in the development of a teaching identity. In some cases, life milestones such as motherhood affect academic trajectories, illustrating how caregiving responsibilities can hinder women's academic progression, particularly in careers with high-time demands.

Secondly, these educators acknowledge that training engineers has unique characteristics that distinguish it from training other professionals and it should be recognized as a distinct and valuable endeavor.

> *I got here by chance. I finished my degree, and started my professional career in a construction company. But at that time, there were five of us sisters, and I found myself in a situation where I left the job, left an architecture firm. I didn't really leave it; I decided to change because there were some personal issues, something that didn't convince me. So, I started looking for another job. And in that impasse, some positions opened up at the university. I already had some professional experience, so I went ahead and filled out the papers. My thesis took several years to complete because I had no funding whatsoever. It was a period when I was on maternity leave with my child, so I was also unable to dedicate much time to it.* (Interviewee 5)
>
> *Apart from teaching them basic knowledge that is indisputable, in the sense of knowing how certain things work, it's important that they can have reasoning and thinking skills. And I often say, "Engineer comes from ingenuity." That ingenuity means having the ability to develop methods, systems, and solutions for everyday life.* (Interviewee 2)

On the other hand, in the case of engineers who trained future STEM teachers, the personal reasons they gave for being educators involved the need to have a job that offers stability and interest in contributing to society through the training of future engineering professionals. Nevertheless, on a personal level, they did not always imagine themselves as university professors, so in many cases, it was a fortuitous decision.

> *In 1989, the opportunity to be a part-time university professor arose, and I combined my work in the company with teaching here at the university as a part-time professor*. (Interviewee 8)
>
> *I did a master's in innovation and discovered the potential it had. I love contributing to society, not only at the company level but more on the social side. In education, I found that by raising awareness among people, significant changes can be made for society. Training technology teachers is a challenge because they come very rigid, wanting to replicate what they have already experienced because they cannot conceive of any other type of education. When I discussed all this with my father, who was a professor, he would say, "How can they explain engines and ships without having visualized an engine?"* (Interviewee 7)

Finally, in the case of engineers who were prospective STEM teachers, personal aspects emerged concerning vocational choice, creating motivation to pursue a teaching career. Participants also recognized that on a personal level, certain characteristics would allow them to become good teachers that are not necessarily learned at the university. Ultimately, they said they view the engineering profession as something distant from education, so they considered personal characteristics as crucial for engineers who want to be dedicated to education.

> *I studied computer engineering in Seville, which took me four and a half years. When I was little, I always had the idea of becoming a teacher when I grew up. Once I finished my degree, I worked for a year and decided to study to become a teacher. I'll decide in the future whether I do it or not, whether I dedicate myself to being a teacher or not. I also don't know if I will continue working as a computer engineer*. (Interviewee 13)
>
> *I had experience giving private lessons. I liked teaching, and I said to myself, "Well, let's take the step, I'll try it."* (Interviewee 15)

Similar to engineers who train future engineers, the life trajectories of women revealed that the decision to enter the field of education was shaped by cultural barriers, hostility, caregiving responsibilities, and gender gaps in certain disciplines. Experiences of exclusion in male-dominated environments, motherhood, and the pursuit of work–life balance emerged as key factors influencing career decisions, with the gender gap in vocational education identified as a variable affecting professional choices.

> *In my first company, the environment was extremely male-dominated. Out of a total of 20 employees, only four of us were women. That wasn't the main issue, though—the real problem was that the rest of the men were very sexist. The atmosphere was far from ideal*. (Interviewee 14)
>
> *I had children, and balancing work and family life became increasingly difficult. In the end, I decided to move to a private school right next to my children's school, which made it much easier to manage*. (Interviewee 16)
>
> *The curriculum I teach in vocational education feels more natural to me, although it is still a field where there aren't many women*. (Interviewee 15)

4.2 Professional dimension

Engineers who trained future engineers recognized university teaching as a professional performance area that should require specific training. Despite many seeking this training, they questioned why it is not a requirement for entry to work at the university. Therefore, feelings of anxiety and insecurity arose regarding performance in an area for which they were not always prepared, leading to experiences of loneliness in the beginning. Thus, they mentioned peer learning as substantial in the acquisition of a true teaching identity and said it should occur in academic departments. However, this can be viewed as a challenge for universities because it currently serves as a substitute for institutional support. Likewise, experiences of workforce entry are often shaped by cultural or structural barriers in the university environment, suggesting potential gender inequality in access to academic roles in engineering.

These findings reveal a significant institutional challenge because they place educators in a vulnerable position, particularly at the start of their academic careers, due to a lack of prior pedagogical training. They also highlight the absence of resources and support mechanisms that could assist new educators in building confidence in their teaching roles.

> *When I started working in the Department of Graphic Expression, the task was too much for me. I had to spend a lot of time studying to prepare the classes. ... There is a lack of facilitation of resources, of documents that can help you develop more confidence because you are in a different facet of your profession; you are training technicians. Although I initially had some support from professors who were in the same subject, I found myself a bit alone.* (Interviewee 2)
>
> *To teach at the university, you are not required to have prior training. To teach in schools, you do need the pedagogical adaptation course or a master's. But for us who are going to teach at the university, we are not prepared.* (Interviewee 3)
>
> *I was the first woman to join that group. Others have joined since, but I was the first, and I am aware that some colleagues were initially resistant to my presence.* (Interviewee 5)

Similarly, in this group, participants noted perceptions that interaction dynamics between students and teachers may vary depending on their genders. Additionally, they described women as more consistent in their academic work. This could reflect the presence of gender-related stereotypes or expectations.

> *In our field, if you are a female professor, male students find it harder to open up, and if you are a male professor, it is more difficult for female students. But in the end, a sense of group cohesion develops. Nowadays, female students are more empowered.* (Interviewee 1)
>
> *Women in this school tend to be more systematic and consistent in their work than men. Generally, female students achieve greater academic success. I find them more focused and hardworking.* (Interviewee 4)
>
> *Female students may be more persistent than male students. Girls always show more interest.* (Interviewee 2)

Regarding engineers who train future STEM teachers, becoming university professors and developing a teaching identity was strongly influenced by the group they teach at the university. They reported a sense of social commitment and collective identity that led them to attribute significant importance to their roles. They said that

training future teachers places them in a position of high contribution and social responsibility.

This professional responsibility exists despite insufficient support, because it takes place in a context in which educators do not always have adequate training or resources. Nevertheless, they indicated strong interest in contributing to the analysis of critical issues, such as gender inequalities in engineering, from an educational perspective.

> *We are preparing future teachers and well, that motivates us, and I think it is another element for us to think that we must do it better and better. It's not only another subject, but a subject that ultimately contributes to people who will stand in front of a group of students and who must do it well, and we will have contributed a small grain of sand to ensure they do it well*. (Interviewee 8)
>
> *I am more focused on gender issues in science education, examining the challenges related to the gender gap in engineering careers—why it occurs, what factors might influence it, and what we can do through education to improve these circumstances*. (Interviewee 12)

Finally, engineers who were prospective STEM teachers described the teaching identity as distant from the engineer identity, making the experience of internships in schools fundamental. During their training as STEM teachers, the role of the school tutor who hosted them during their internships was central because it helped them build a professional and occupational identity in the field of education. In this context, they recognized an added value: when engineers are teachers, they are capable of using their creativity to solve everyday problems that other teachers might not. They associated being an engineer with being creative in solving problems, thus having a unique and distinctive professional component.

> *I believe that engineers are problem solvers, and in the end, at a school, you have to be solving problems. We are very practical people*. (Interviewee 16)
>
> *I knew my school tutor from before. He did me the favor of stepping in because he doesn't usually guide internships. He told me, "Look, listen to me." He is constantly explaining things to me*. (Interviewee 14)

4.3 Situational dimension

Engineers who train future engineers have an ongoing debate regarding the professional role of their students. Social factors play a central role in this discussion because the status of the profession declined following the construction crisis in Spain, which also affected the status of teaching in this field. This event not only diminished the profession's prestige but also appears to have influenced how engineers perceive their teaching role, given they had to adapt to a context in which construction ceased to be a prominent sector.

Additionally, the social perception of building engineering as a "dependent" profession has affected the professional self-esteem of educators and their role in training future engineers. As a result, power dynamics between professions have influenced how university instructors perceive their work and its societal impact.

> *Being a building engineer in Spain used to be a privilege—you were practically God's right-hand man. But after the 2008 crisis, when the construction sector*

collapsed, everything plummeted. This university has made a significant effort to support all areas of engineering. (Interviewee 1)

Our degree enjoys broad and high recognition, but compared to other fields, it is not in the best position. Sometimes, it is perceived as a dependent profession when in reality, it is not. (Interviewee 4)

However, a high responsibility associated with the profession persists, along with the need to create spaces for continuous training and peer learning in interuniversity communities that diversify the ways of contextualizing engineering teaching. This interaction with other university professors, as a way to stay updated and review approaches, reflects the influence of changes and trends in higher education and the necessity to adapt to new pedagogical paradigms.

A building engineer has a very strong, very powerful responsibility, which is to make homes. Having a team of people working alongside you who could be at risk implies a very powerful responsibility. ... Being a building engineer in Spain was a luxury; you were almost divine. But since the 2008 crisis, when construction fell, everything plummeted. This university has made a great commitment to all engineering, and we have been running a program for years to bring engineering closer to new generations, especially to women and girls. (Interviewee 1)

With many professors from other universities, we try to see how we do it, exchange information, look, and consider teaching situations. Opening up, in my case, offers me fresh air, making me think about things differently in the classes. (Interviewee 6)

Finally, in this group, teaching identity got shaped by the impact of new pedagogical skills in response to technological advancements in society. The teaching identity in engineering has had to evolve to incorporate critical discernment skills regarding digital information. Teaching is no longer solely about knowledge transmission but also about guiding students in evaluating and applying information in a practical context.

Nowadays, with the internet, I encourage students to use it, but I also want them to be able to discern whether the solutions they find are valid or not. ... If they are not, how could they adapt them to make them work? (Interviewee 2)

The impact of technological advancements on university teaching is also evident among engineers who train future STEM teachers, highlighting shifts in teaching practices and the subsequent redefinition of the instructor's role. The COVID-19 pandemic and artificial intelligence have transformed education, forcing educators to rapidly adapt to new tools and methodologies. As a result, university teaching is now recognized as not only knowledge transmission but also the ability to manage and critically assess technology in learning.

We found ourselves in a completely new situation. All of us who teach had to update our skills in a forced manner due to online education. ... Then artificial intelligence emerged, and students started using tools like ChatGPT to complete their assignments. (Interviewee 9)

In this group, the situational nature of teaching identity is evident in how educators assessed the impact of the teaching profession on society. As such, these

university professors assumed a high level of responsibility in the training of future secondary school teachers and said they aim for their students to feel empowered in their classes to drive future changes.

> *I teach project management subjects, and I have dedicated my entire life to managing projects. I am not telling them something I learned from a book. It has always been very satisfying to say, "Look, I use it in this context in this way." The students value that a lot*. (Interviewee 8)
>
> *We must give back to society, not only stay in the classroom but engage in service-learning activities or with activism projects that seek a scientific-technological analysis and then a proposal*. (Interviewee 7)
>
> *I believe that to make the subject more attractive to a student, we must master the topic. That is, if I explain something or link it to another idea, it's because I have mastered it*. (Interviewee 10)

In this group, the influence of the economic crisis and its impact on institutional barriers is also evident. The instability of the private sector led many engineers to reconsider their professional paths and transition into teaching. However, some engineers faced resistance when attempting to enter spaces traditionally occupied by education specialists.

> *I used to work in an engineering firm, but after the 2008 crisis, everything started to go downhill. ... Academia was not an obvious path because the field of science didactics was not very open to engineers. But in the end, I was awarded a scholarship, and that's how I began my transition into teaching*. (Professor 12)

Finally, in the case of engineers who were prospective STEM teachers, prior professional experience seemed to have weighed heavily than the possibility of projecting a future with a new professional identity. This was evident in expressions of feeling more secure and valued if they imagined working with higher-level technical trainees rather than secondary school students.

The appreciation of engineers' prior professional experience highlights how their connection to industry and practical expertise becomes a key pedagogical resource. This also underscores how technological advancements and the evolution of skills demanded in the labor market shape engineers' perception of their role as educators.

> *Students in higher education appreciate it if the teacher has work experience because you share your experience with them. They might see you as a valuable figure. Having worked in the telecommunications sector, for the student, it's good to see someone from the industry*. (Interviewee 15)

Nonetheless, certain situational elements can be observed regarding the tension between a genuine vocational calling for teaching and the pursuit of economic stability. Many engineers said they view teaching as a stable alternative in contrast to the uncertainty of the private sector. This, sometimes, led to a mismatch between expectations and the reality of the master's program required to become a teacher, because some students perceived the program as merely a procedural step rather than effective training for teaching.

> *The mentor at the institute, the one overseeing the practicum, is someone who doesn't enjoy teaching and only got into this for job stability. ... People I knew who*

had completed the master's told me it was just a formality, and to be honest, I see it that way, too. (Interviewee 13)

At the time, I had no work experience, but I had already decided to continue in education as a backup plan or as a future career option. (Interviewee 15)

5 DISCUSSION

First, engineers who train future engineers constructed their teaching identity based on personal circumstances that led them to university teaching. Over time, they gradually integrated these experiences with their personal and family histories, highlighting the influence of professional trajectories in shaping teaching identity [41]. However, their transition to teaching was not always driven by a clear vocational choice but rather by employment opportunities that they later reframed through their teaching practice. This finding reinforces the notion that teaching identity is not a fixed starting point but a dynamic and evolving process shaped by social and contextual interactions [37]–[39], [47], [49]. This is evidence that teacher identity was shaped by changing experiences of being, becoming, and belonging [36].

This group also valued the training of engineers through a strong sense of commitment and ethical awareness, recognizing the significant social impact of the discipline [2], [4], [6]. Consequently, they viewed their role as educators as crucial and said that specific training should be required for university teaching to ensure the acquisition of necessary competencies for effectively teaching engineering [7].

Nonetheless, the lack of specialized pedagogical training and limited institutional support emerged as critical challenges, generating anxiety and insecurity during their early years in teaching, forcing them to adapt to new identities and teaching methodologies, often without structured training [7], [8]. Although the literature has emphasized the importance of peer learning in consolidating teaching identity [34], [35], our findings indicate that for this group, peer learning functioned more as a survival strategy than a structured professional development opportunity. This underscores the need for universities to implement structured induction programs for engineers transitioning into academia, facilitating their adaptation and reducing their vulnerability at the beginning of their teaching careers [46].

In contrast, engineers who train future STEM teachers perceived the university as a stable work environment where they can contribute to society. Like the previous group, many of them entered university teaching by chance and gradually developed their own approach to teaching. This further confirms the importance of professional trajectories in shaping teaching identity [41] reinforcing the idea that teaching identity is molded by interactions with the environment and teachers' representations of their roles [40].

In this particular case, a strong sense of professional responsibility is evident because these educators perceived their role as shaping future change agents in STEM education. This is significant because their teaching identity constructed through not only content instruction but also through their ability to influence the transformation of future generations of educators. This highlights the role of perceived professional commitment in shaping teaching identity [50], [51] and illustrates how teachers' representations of their roles influence their teaching identity [40], despite the tensions that may arise in this process [45].

Finally, unlike the previous two groups, engineers training to become STEM teachers said they explicitly chose teaching as a vocation and recognized their personal characteristics as assets for their future teaching careers. However, they did not

identify significant intersections between their engineering and teaching identities, indicating that they must construct a new identity during their teaching practicum. Nevertheless, they acknowledged that coming from a practice-oriented profession might be advantageous when they begin their teaching careers. These findings reveal that the perceptions and emotions associated with professional practice are key determinants of teaching identity [40].

In this context, mentors played a crucial role as models for these future educators [3], while the school, as a specific cultural setting, became a privileged space for the construction and negotiation of identity [32]. It is through interactions with mentors and practicum experiences that the alignment between perceived and assigned roles in teaching identity was established [50], [51].

It is likely that although these future STEM teachers did not recognize an explicit connection between their engineering and teaching identities, the strong emphasis on prior professional experience provided them with a sense of security in envisioning themselves as teachers of students similar to them. This suggests that they may feel more aligned with teaching in higher education than with secondary school STEM education. This issue requires further exploration, given the implications of this group ultimately teaching STEM subjects despite exhibiting low self-efficacy perceptions in this area [17], [18].

These findings reinforce the importance of considering personal trajectories in teaching identity, emphasizing that engineering education extends beyond the transmission of technical knowledge to encompass significant ethical and social commitments. In this regard, teacher-training programs for engineers should focus on not only pedagogical skill development but also fostering a professional teaching identity that integrates these values.

Furthermore, institutional support for the transition to teaching is a pressing need across all three groups analyzed, underscoring the urgency of designing induction, mentoring, and support programs to facilitate the consolidation of a strong and autonomous teaching identity.

Despite the significance of these findings, this study did not establish whether a distinct teaching identity exists among engineers who teach, because context and student groups appeared to be more influential factors than disciplinary background [29], [30]. Researchers should investigate teaching identity separately in each group, with particular attention to STEM teachers, who may have lower self-efficacy perceptions compared to other educators.

Another limitation is the cross-sectional approach, which did not capture how teaching identity evolves over time. Professional identity is a dynamic process that changes with experience and educational context. For engineers transitioning to teaching, it remains unclear whether they consolidate their role over time or due to a lack of institutional support and pedagogical training, experience detachment or attrition. Studies should employ longitudinal methodologies to examine this evolution.

Additionally, although the study highlighted the lack of institutional support, it did not delve into how policies and organizational culture influence teaching identity construction. Different institutions may provide varying levels of support and training, leading to diverse experiences. In research-intensive universities, teaching may be perceived as secondary, which hinders the development of a strong teaching identity [44], [45]. Similarly, in schools with rigid curricula, future STEM teachers may face limitations in implementing innovative teaching practices. Analyzing these institutional factors is key to understanding how they facilitate or hinder the transition from engineering to teaching.

Gender inequalities in teaching identity formation among female engineers were also not explored in depth, despite evidence of barriers such as the lack of role

models and the constant need to prove their competence [21], [22]. In universities and schools, women may encounter additional resistance in their teaching roles, affecting their self-efficacy and professional trajectories [23]–[25]. Studies should adopt an intersectional approach to examine how gender and institutional context influence the teaching transition of female engineers.

Finally, the sample size and absence of quantitative methods limit the generalizability of the findings. The study focused on Spanish institutions and specific engineering fields, and findings may not reflect the diversity of experiences in other countries or disciplines. Incorporating quantitative tools could provide measurable insights into teaching self-efficacy, job satisfaction, and the impact of institutional support. However, integrating mixed methods would require careful planning to maintain the depth of qualitative analysis. This study provided evidence on the teaching identity of engineers who teach. However, researchers should address these limitations through longitudinal approaches, policy analysis, and the inclusion of gender perspectives and quantitative methods to deepen understanding.

6 ACKNOWLEDGMENTS

The authors thank the National Agency for Research and Development (ANID) Beca Chile Postdoctoral Fellowship Abroad 2022-74220039, the ANID Doctoral Program Strengthening Project 2022-Folio 86220041 (University of Playa Ancha), and the Doctorate in Educational Sciences at the University of Granada.

7 REFERENCES

[1] R. Doron, "To be or not to be an educator? The dilemma facing the engineering teacher," *European Journal of Engineering Education*, vol. 17, no. 4, pp. 421–426, 1992. https://doi.org/10.1080/03043799208923197

[2] S. Cáceres, G. Aleixandre, and F. J. Gómez, "Las implicaciones sociales de la práctica de la ingeniería como espacio para la reflexión filosófica en la formación de los ingenieros," *Azafea: Revista de Filosofía*, vol. 24, pp. 39–64, 2022. https://doi.org/10.14201/azafea2022243964

[3] V. Grande, T. T. Lennerfors, A.-K. Peters, and K. von Hausswol, "The virtuous, the caring, and the free: Ethical theory to understand the ethics of the teacher as a role model in engineering education," *European Journal of Engineering Education*, vol. 49, no. 1, pp. 1–21, 2024. https://doi.org/10.1080/03043797.2023.2236959

[4] N. V. Hanh, N. T. Long, N. T. Duyen, P. T. T. Canh, N. T. Long, and M. D. Thang, "Teaching engineering ethics through a psychology course," *International Journal of Engineering Pedagogy (iJEP),* vol. 11, no. 1, pp. 16–34, 2021. https://doi.org/10.3991/ijep.v11i1.14999

[5] N. V. Hanh and N. T. Long, "The ethical perception of engineering students who have never participated in the ethics curriculum," *International Journal of Engineering Pedagogy*, vol. 12, no. 1, pp. 4–20, 2022. https://doi.org/10.3991/ijep.v12i1.21781

[6] I. Ishmuradova, T. V. Sazonova, S. A. Panova, I. S. Andryushchenko, N. A. Mashkin, and V. L. Zakharova, "Examining preservice science teachers' perspectives on the social responsibility of scientists and engineers," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 19, no. 8, p. em2315, 2023. https://doi.org/10.29333/ejmste/13457

[7] M. Eidenskog, O. Leifler, J. Sefyrin, E. Johnson, and M. Asplund, "Changing the world one engineer at a time – unmaking the traditional engineering education when introducing sustainability subjects," *International Journal of Sustainability in Higher Education*, vol. 24, no. 9, pp. 70–84, 2023. https://doi.org/10.1108/IJSHE-03-2022-0071

[8] P. Vesikivi, M. Lakkala, J. Holvikivi, and H. Muukkonen, "Team teaching implementation in engineering education: Teacher perceptions and experiences," *European Journal of Engineering Education*, vol. 44, no. 4, pp. 519–534, 2018. https://doi.org/10.1080/03043797.2018.1446910

[9] T. Polyakova, "New generation of engineering students: Do we know how to teach them?" in *Learning in the Age of Digital and Green Transition: Lecture Notes in Networks and Systems*, vol. 634, M. E. Auer, W. Pachatz, and T. Rüütmann, Eds., Cham, Switzerland: Springer, 2023, pp. 553–560. https://doi.org/10.1007/978-3-031-26190-9_58

[10] M. Case, "A third approach beyond the false dichotomy between teacher- and student-centred approaches in the engineering classroom," *European Journal of Engineering Education*, vol. 44, no. 5, pp. 644–649, 2019. https://doi.org/10.1080/03043797.2019.1657632

[11] V. L. González-Maura, A. López Rodriguez, J. E. Valdivia Díaz, and K. Carvajal Cuello, "Clima de enseñanza favorecedor del aprendizaje. Un estudio en la Facultad de Ingeniería de la Universidad de Atacama," *Revista Educación*, vol. 43, no. 2, 2019. https://doi.org/10.15517/revedu.v43i2.32773

[12] S. Hartikainen, L. Pylväs, and P. Nokelainen, "Engineering students' perceptions of teaching: Teacher-created atmosphere and teaching procedures as triggers of student emotions," *European Journal of Engineering Education*, vol. 47, no. 5, pp. 814–832, 2022. https://doi.org/10.1080/03043797.2022.2034750

[13] M. Martín-Civantos, C. L. Carrasco-Aguilar, J. O. Torres-Vallejos, and A. Luzón-Trujillo, "Interacción profesor-estudiante dentro del clima de aprendizaje. Un estudio comparativo Chile-España en carreras de ingeniería en construcción," *Formación Universitaria*, vol. 17, no. 2, pp. 139–148, 2024. https://doi.org/10.4067/s0718-50062024000200139

[14] R. M. Lima, V. Villas-Boas, F. Soares, O. S. Carneiro, P. Ribeiro, and D. Mesquita, "Mapping the implementation of active learning approaches in a school of engineering – the positive effect of teacher training," *European Journal of Engineering Education*, vol. 49, no. 5, pp. 945–964, 2024. https://doi.org/10.1080/03043797.2024.2313541

[15] T. T. A. Ngo, "Perception of engineering students on social constructivist learning approach in classroom," *International Journal of Engineering Pedagogy*, vol. 14, no. 1, pp. 20–38, 2024. https://doi.org/10.3991/ijep.v14i1.43101

[16] A. Drobnič Vidic, "Teachers' beliefs about STEM education based on realisation of the 'energy as a value' project in the Slovenian school system," *International Journal of STEM Education*, vol. 33, pp. 408–419, 2017.

[17] A. Kırkıç and E. E. Arıkan, "Primary school teachers' attitudes and views toward STEM education," *Science Education International*, vol. 34, no. 2, pp. 132–141, 2023. https://doi.org/10.33828/sei.v34.i2.7

[18] V. Kumar, M. D. Johnson, B. Nepal, and G. Ghoshal, "Impact of a high value manufacturing research and enrichment experience on self-efficacy of high school STEM teachers," *International Journal of Engineering Education*, vol. 37, no. 4, pp. 925–938, 2021.

[19] T. Herink, V. Bělohlav, T. Jirout, and Z. Bělohlav, "Opportunities of experiential education in chemical technology and engineering," *Education for Chemical Engineers*, vol. 41, pp. 32–41, 2022. https://doi.org/10.1016/j.ece.2022.08.003

[20] N. Kober *et al.*, *Rise and Thrive with Science: Teaching PK-5 Science and Engineering*. Washington, DC: The National Academies Press, 2023. https://doi.org/10.17226/26853

[21] W. H. Fox-Turnbull, M. Moridnejad, P. D. Docherty, and J. Cooper, "Influencing factors on women in connection with engineering in New Zealand: A triad of lenses," *International Journal of Technology and Design Education*, vol. 34, pp. 1045–1066, 2024. https://doi.org/10.1007/s10798-023-09854-6

[22] H. Wao *et al.*, "Examining how social networks influence women and under-represented minority students' pursuit of engineering in university: When, who, and how?" *International Journal of STEM Education*, vol. 10, 2023. https://doi.org/10.1186/s40594-023-00415-w

[23] Epifanio and E. Calvo-Iglesias, "Acciones para la igualdad de género en las áreas científico-técnicas de las universidades españolas," *Educación XX1*, vol. 27, no. 2, pp. 19–36, 2024. https://doi.org/10.5944/educxx1.38279

[24] O. A. Lasekan, M. T. Godoy Pena, A. J. Odebode, A. P. Mabica, R. A. Mabasso, and O. Mogbadunade, "Fostering sustainable female participation in STEM through ecological systems theory: A comparative study in three African countries," *Sustainability*, vol. 16, no. 21, p. 9560, 2024. https://doi.org/10.3390/su16219560

[25] U. Nguyen and C. Riegle-Crumb, "Gender typicality and engineering attachment: Examining the viewpoints of women college engineers and variation by race/ethnicity," *Behavioral Sciences*, vol. 14, no. 7, p. 573, 2024. https://doi.org/10.3390/bs14070573

[26] Y. A. Garcés-Gómez, V. Cadavid Alzate, A. M. Rodríguez Ortiz, and R. D. Lara Escobar, "Teachers' self-perception of scientific competences: A gender approach," *International Journal of Evaluation and Research in Education*, vol. 13, no. 4, pp. 2428–2439, 2024. https://doi.org/10.11591/ijere.v13i4.27724

[27] S. Papadakis, C. Tousia, and K. Polychronaki, "Women in computer science. The case study of the Computer Science Department of the University of Crete, Greece," *International Journal of Teaching and Case Studies*, vol. 9, no. 2, pp. 142–151, 2018. https://doi.org/10.1504/IJTCS.2018.090963

[28] S. Papadakis, "Gender stereotypes in Greek computer science school textbooks," *International Journal of Teaching and Case Studies*, vol. 9, no. 1, pp. 48–71, 2018. https://doi.org/10.1504/IJTCS.2018.10011123

[29] Z. Doganca Kucuk, S. E. Genek, H. S. Bozoglu, and M. S. Corlu, "Expressed willingness of STEM teachers to teach engineering," *Journal of Pre-College Engineering Education Research*, vol. 13, no. 1, pp. 55–69, 2023. https://doi.org/10.7771/2157-9288.1358

[30] C. Schaben, J. Andersson, and C. Cutucache, "A multiple case study to understand how students experience science and engineering practices," *Frontiers in Education*, vol. 7, p. 960346, 2022. https://doi.org/10.3389/feduc.2022.960346

[31] Y. Rakhat *et al.,* "Ethical perceptions of engineering faculty students," *International Journal of Engineering Pedagogy*, vol. 12, no. 2, pp. 88–100, 2022. https://doi.org/10.3991/ijep.v12i2.29335

[32] A. Hargreaves, *Profesorado, Cultura y Posmodernidad: Cambian los Tiempos, Cambia el Profesorado*. Madrid, Spain: Morata, 2005.

[33] Fullan, *The Principal: Three Keys for Maximizing Impact*. San Francisco, CA: Jossey-Bass, 2014.

[34] D. Schön, *The Reflective Practitioner: How Professionals Think in Action*. New York, NY: Basic Books, 1983.

[35] Stenhouse, *La Investigación Como Base de la Enseñanza*, 2nd ed. Madrid, Spain: Morata, 1996.

[36] D. Cuadra-Martínez *et al.*, "Preservice teacher professional identity: Influence of the teacher educator and the teacher education model," *Education Policy Analysis Archives*, vol. 31, no. 86, 2023. https://doi.org/10.14507/epaa.31.7631

[37] K. Bagga, "Being, becoming, and belonging: Professional identity of teacher educators," *Education and Self Development*, vol. 19, no. 3, pp. 38–49, 2023. https://doi.org/10.26907/esd.18.3.03

[38] M. Skogheim, "I stay because of my students': Urban lower secondary school teachers' experiences of belonging at work," *Nordic Journal of Comparative and International Education*, vol. 7, no. 4, 2023. https://doi.org/10.7577/njcie.5533

[39] Skott, "Changing experiences of being, becoming, and belonging: Teachers' professional identity revisited," *ZDM Mathematics Education*, vol. 51, pp. 469–480, 2019. https://doi.org/10.1007/s11858-018-1008-3

[40] C. Monereo and C. Domínguez, "La identidad docente de los profesores universitarios competentes," *Educación XX1*, vol. 17, no. 2, pp. 83–104, 2014. https://doi.org/10.5944/educxx1.17.2.11480

[41] A. El-Soussi, "The shift from face-to-face to online teaching due to COVID-19: Its impact on higher education faculty's professional identity," *International Journal of Educational Research Open*, vol. 3, p. 100139, 2022. https://doi.org/10.1016/j.ijedro.2022.100139

[42] R. Argemí i Baldich, "La identidad profesional docente: Concepto en constante (re) novación y (re)configuración. Estudio de caso en el Recinto educativo Llars Mundet (Barcelona)," in *Aprender a Ser Docente en un Mundo en Cambio: Simposio Internacional*, J. M. Sancho, J. M. Correa, X. Giró Gràcia, and L. Fraga Eds., Barcelona, Spain: University of Barcelona, 2014, pp. 295–303.

[43] A. I. Ponce Gea and M. L. Rico Gómez, "Dificultades y propuestas para el maestro ideal del siglo XXI: Un modelo desde la teoría fundamentada," *Qualitative Research in Education*, vol. 11, no. 1, pp. 1–28, 2022. https://doi.org/10.17583/qre.8865

[44] N. Ivanova and E. Popova, "Professionals and the problem of implementing innovation in university," *Educational Studies Moscow*, no. 1, pp. 184–206, 2017. https://doi.org/10.17323/1814-9545-2017-1-184-206

[45] Karjalainen and S.-P. Nissilä, "Higher education teachers' conceptions of professional development and change: A longitudinal case study of university pedagogy prospects," *International Journal of Educational Methodology*, vol. 8, no. 3, pp. 609–623, 2022. https://doi.org/10.12973/ijem.8.3.609

[46] G. F. Melo and V. T. B. Campos, "University pedagogy: For an institutional teaching development policy in higher education," *Cadernos de Pesquisa*, vol. 49, no. 173, 2019. https://doi.org/10.1590/198053145897

[47] Å. N. Akslen, M. Ohm, and A. Hu, "'I'll take it with me all my life': A case study of student teachers' professional identity development," *Nordic Journal of Comparative and International Education*, vol. 7, no. 3, 2023. https://doi.org/10.7577/njcie.5527

[48] F. A. Rodrigues and M. J. Mogarro, "Imagens de identidade profissional de futuros professores," *Revista Brasileira de Educação*, vol. 25, p. e250004, 2020. https://doi.org/10.1590/s1413-24782019250004

[49] E. Pilcher, "'Moving in more closely': Using Q methodology to explore preservice teacher identity formation as a complex dynamic system," *International Journal of Educational Research Open*, vol. 5, p. 100265, 2023. https://doi.org/10.1016/j.ijedro.2023.100265

[50] D. Meyer, J. Doll, and G. Kaiser, "Professional identity of pre-service teachers: Actual and designated identity profiles and their relationship to teacher education programs," *Frontiers in Education*, vol. 8, p. 1134848, 2023. https://doi.org/10.3389/feduc.2023.1134848

[51] W. Reid *et al.*, "Perceived network bridging influences the career commitment decisions of early career teachers," *International Journal of STEM Education*, vol. 10, 2023. https://doi.org/10.1186/s40594-023-00408-9

[52] D. J. Clandinin and F. M. Connelly, *Narrative Inquiry: Experience and Story in Qualitative Research*. San Francisco, CA: Jossey-Bass, 2000.

[53] J. I. Rivas-Flores *et al.*, "Ética, responsabilidad y trabajo colectivo en la investigación narrativa," *New Trends in Qualitative Research*, vol. 5, pp. 139–151, 2021. https://doi.org/10.36367/ntqr.5.2021.139-151

[54] A. Ljalikova, M. Meristo, E. Alas, and M. Jung, "Narrative analysis as a means of investigating CLIL teachers' meaningful experiences," *Qualitative Research in Education*, vol. 10, no. 3, pp. 228–259, 2021. https://doi.org/10.17583/qre.7511

[55] J. Paredes Labra and A. Freitas Cortina, "Las representaciones de los futuros profesores sobre los usos de la tecnología en la escuela. Un estudio narrativo," *Teoría De La Educación: Revista Interuniversitaria*, vol. 32, no. 2, pp. 157–180, 2020. https://doi.org/10.14201/teri.21616

[56] P. Cortés González, A. E. Leite Méndez, and J. I. Rivas Flores, "Un enfoque narrativo de la identidad profesional en profesorado novel," *Tendencias Pedagógicas*, vol. 24, pp. 199–214, 2015. https://doi.org/10.15366/tp2014.24.013

[57] C. Martins, L. Tinoca, and M. G. Alves, "On the effects of Erasmus+ KA 1 mobilities for continuing professional development in teachers' biographies: A qualitative research approach with teachers in Portugal," *International Journal of Educational Research Open*, vol. 7, p. 100368, 2024. https://doi.org/10.1016/j.ijedro.2024.100368

[58] J. E. Mosquera-Pérez and J. J. Losada-Rivas, "EFL teachers' professional identity: A narrative study with Colombian graduate students," *Profile: Issues in Teachers' Professional Development*, vol. 24, no. 2, pp. 47–62, 2022. https://doi.org/10.15446/profile.v24n2.91744

[59] Q. Patton, *Qualitative Research and Evaluation Methods: Integrating Theory and Practice*. Thousand Oaks, CA: Sage, 2015.

[60] Altan and J. F. Lane, "Teachers' narratives: A source for exploring the influences of teachers' significant life experiences on their dispositions and teaching practices," *Teaching and Teacher Education*, vol. 74, pp. 238–248, 2018. https://doi.org/10.1016/j.tate.2018.05.012

[61] K. Riessman, *Narrative Methods for the Human Sciences*. Thousand Oaks, CA: Sage, 2008.

8 AUTHORS

Claudia Carrasco-Aguilar is the Principal Investigator of the project. She holds a Ph.D. in Educational Sciences and is a Full Professor and Researcher in the Department of Mediations and Subjectivities at the University of Playa Ancha, Chile. Her research focuses on teaching identity and professional development (E-mail: claudia.carrasco@upla.cl).

Sebastián Ortiz-Mallegas holds a Ph.D. in Educational Sciences and is an Associate Professor and Researcher in the Department of Mediations and Subjectivities at the University of Playa Ancha, Chile. His research focuses on teacher unionism and civic education (E-mail: sebastian.ortiz@upla.cl).

Mariano Martín-Civantos holds a Ph.D. in Educational Sciences and currently works as an independent researcher. His research focuses on the training of engineering students (E-mail: mariano.martin@civantos.com).

Antonio Luzón holds a Ph.D. in Education and is a Full Professor in the Department of Pedagogy at the University of Granada, Spain. His research focuses on comparative education policies, citizenship, and social education (E-mail: aluzon@ugr.es).