# Sense of Belonging of Women in Construction: Insights from Focus Groups

**Dr. Monica Quezada-Espinoza, Universidad Andres Bello, Santiago, Chile**

Monica Quezada-Espinoza is a professor and researcher at the School of Engineering at the Universidad Andres Bello in Santiago, Chile, where currently collaborates with the Educational and Academic Innovation Unit, UNIDA (for its acronym in Spanish), as an instructor in active learning methodologies. Her research interest topics involve university education in STEM areas, faculty and continuing professional development, research-based methodologies, community engagement projects, evaluation tools and technology, and gender issues in STEM education. https://orcid.org/0000- 0002-0383-0179

**Prof. Marcela Silva, Universidad Andres Bello, Santiago, Chile**

Marcela Silva is the Academic Director at the Engineering Faculty of the Andres Bello University in Campus Santiago. She works as a teacher in the Construction Engineering career and supports innovation and entrepreneurship courses. She obtained a Bachelo

**Dr. Carolina Alvarado, California State University, Chico**

Dr. Alvarado is currently an Associate Professor in the Department of Science Education at California State University, Chico. She holds a bachelor's degree in Engineering Physics and a doctorate in Physics Education from Tecnológico de Monterrey. Her work focuses on supporting K-12 teachers to implement culturally responsive scientific practices to empower students. Her approach to teaching physics relies on making connections between scientific practices and society. Dr. Alvarado is the Principal Investigator of an NSF grant that studies socio-metacognition, emotions, and power dynamics when undergraduate physics students engage in collaborative activities that elicit confusion; a collaborative grant with Dr. Thanh Lê at Western Washington University. She is also working in a study that explores STEM faculty implementing Classroom-based Undergraduate Research Experiences in introductory courses; this is a collaboration with Dr. Laura Rios at California Polytechnic State University, San Luis Obispo.

# Sense of belonging of women in construction: Insights from focus groups

**Abstract**
The sense of belonging of women in male-dominated spheres is a factor that hinders the closing of gender gaps. An extensive body of research that analyzes the sense of belonging of women who work in the fields of science, technology, engineering, and mathematics concludes that the improvement of this factor increases the self-confidence, academic performance, and retention rates of women therein. The field of construction engineering is one of the most male-dominated professions and it is, therefore, important to understand the way in which women who pursue a career in this particular field conceive of their sense of belonging. Furthermore, an evaluation of the experiences of such women and how these have impacted and influenced their career and contributed to their sense of belonging to the field of construction would enhance the aforementioned understanding**.** Accordingly, this research analyzes the perspectives of women related to a construction engineering program, as students, alumni working in the field, and faculty in a construction program, regarding their sense of belonging. We categorize their experiences and their proposed solutions to improve that sense of belonging of women in the field of construction. Through a qualitative approach, the main findings are reported on three focus groups held with ten women, all students, former students, and teaching professionals from a Construction Engineering degree program at a private Chilean university. This methodology presents results regarding participant perception of their sense of belonging, their positive and negative experiences in an environment related to construction, whether in the campus or work context, and their proposed solutions for enhancing this sense of belonging within the sector. Despite differences in participants' life stages, they all believe that self-confidence, recognition from peers and leaders, social interactions, and knowledge and skills are critical factors that improve their sense of belonging.
***Keywords:*** focus groups; sense of belonging; women in construction

## Introduction

Latest figures from the National Employment Survey conducted by the Chilean National Statistics Institute [1] show that female participation in the labor market in the quarter from November 2021 to January 2022 was 48.3%. This contrasts with particular economic sectors that have been traditionally male-dominated, such as construction, in which female participation in 2021 was a mere 9.6%. Other parts of the world report similar statistics, for example, women account for just 9.9% of the construction labor force in the United States [2]. Similarly, Regis et al. [3] state that this figure exceeds no more than 10% in Brazil. A salient fact is that women's participation in the labor force is at office and sales positions, where they represent 45% of the market. This figure drops to less than a third among management positions, at 31%.

This gender gap of women’s participation in construction is not limited to the industry level but it is also observed in the academic sphere. For example, in a private Chilean university (where

the study was performed) women undergraduate students pursuing a degree in Construction Engineering (CE) represent about 10% of the student body. While the level of participation of women has increased over time, we can see a need for action to close this gender gap [4]. The representation and visibility of women in this degree program, and all science, technology, engineering, and mathematics (STEM) programs in general, is a crucial element to tackle in order to strengthen the self-confidence of the women pursuing a career in these areas.

Self-confidence is influenced by both internal and external elements of every student, which in turn affects the sense of belonging a person may feel, which can be improved by their environment and personality traits. In this regard, Whitcomb et al. [5] discuss the extent to which the perceived recognition by peers, teaching professionals, and family members, among others, impacts the self-efficacy and interest of students since the way they are seen by others directly influences how they see themselves.

Based on a literature review, this research found that, despite the existence of several investigations into the sense of belonging of women in construction careers, this factor has not been studied in any depth in the Chilean context. Thus, it is important to examine the factors that facilitate a more detailed understanding of the sense of belonging of women in the national construction industry. Furthermore, there are not many studies exploring the experiences of women at different stages of their career in CE to see how their perceptions of sense of belonging changes as they graduate from the program and incorporate in the field of construction.

This research analyzes the perspectives of women related to a construction engineering program, as students, alumni working in the field, and faculty in a construction program, regarding their sense of belonging. We categorize their experiences and their proposed solutions to improve that sense of belonging of women in the field of construction.

**Literature review**

Our conceptual framework is based on two main components: the factors that drive women to drop out of the construction industry and women's sense of belonging in construction. We will further elaborate on how these factors have been examined in multiple contexts. Several studies in the United States [6-9] have focused on attempts to understand why women drop out of STEM careers. For instance, Delahanthy and Silverman [7] conducted a study with a sample taken in Philadelphia, finding self-efficacy, a factor related to the sense of belonging, is closely related to previous classroom experiences and the students' relationships. Other studies associated women dropping out of STEM programs with the classroom climate, academic performance, and the student's economic situation; having a positive experience in these aspects correlates to students' sense of belonging [8, 9]. Similarly, a study in Ireland [10] associates students’ belongingness with positive social interaction with other students. As in [7], they

mention that creating inclusive learning environments for all students is essential. Looking at the sense of belonging has been identified as a focus factor addressed by research studies, amongst other factors [9-12].

In highly male-dominated degree programs, such as Computer Engineering or Construction Engineering, the sense of belonging among female students has been found to be affected by a lack of identity with male peers, which is identified as a cause for them to drop out of the degree at an early stage [4, 13]. The culture promoted within the field of construction in general is also a factor that discourages women from entering or remaining in a career in this sector. Weston & Lopez [14] argue that women in primarily male-dominated fields often feel the need to "de-gender" themselves, pushing women in the industry to reshape themselves to fit into their profession. In other words, they feel the need to reject some of their feminine attitudes and take on masculinized attitudes in order to gain acceptance by the dominant culture. Identity and sense of belonging are two factors that impact directly on the self-efficacy of female students, i.e., their self-perception of being able to perform a particular task. These same factors have been identified as related to student academic performance and dropout [15].

The sense of belonging of women in STEM fields has been the subject of extensive research, which has led to multiple conceptualizations. For example, Debs & Kota [15] extends definitions of sense of belonging to center women's sense of belonging in the construction industry. They identify that the presence of gender stereotyping, low sense of belonging, lack of support system, and lack of female role models continues to push women out of pursuing a degree in construction or stay in this industry. Whitcomb et al. [5] call it social belonging, within a context of a learning environment, and define it as a fundamental human need; they claim that feelings of exclusion distract students from being entirely mentally present, which can result in them failing to take advantage of, or fully participating in classroom learning situations. Andrews et al. [16] state that a sense of belonging is generally related to individual self-perception regarding the ability to adapt to a given context, whether academic or social.

Our study expands the current literature in understanding how women perceive the sense of belonging by including three different populations of women in CE: undergraduate students who are pursuing a career in CE, alumni who are now working in the industry, and faculty members who work in a CE program and have experience in the industry. We highlight the importance of belonging in the academic setting and in the industry of construction. Therefore, the request questions we are pursuing in this study are:
RQ1. How do women involved in CE conceptualize a sense of belonging in CE?
RQ2. What type of experiences do women in CE identify as supporting their sense of belonging in their field?
RQ3. What type of experiences do women in CE identify as negative towards their sense of belonging in their field?

RQ4. What type of actions women in CE consider can improve their sense of belonging in this field?

**Methodology**

This is a qualitative study based on findings from focus groups that utilizes a purposeful sampling method. We selected three populations for the focus group centering female experiences in CE: students in an undergraduate CE program, alumni from the CE program who are currently working in the field, and faculty members in the CE undergraduate program. The data was collected during the second half of 2022 in a private university in Chile. During this period, there were 199 active students enrolled on the program, of which 9.5% (19) were female and 90.5% (180) were male. Over the last 5 years, the average annual enrolment for the CE degree has been 40.2 students, of which, on average, 12% are women. Over the same period, 155 students have graduated, 13.5% of which have been women (on average 4.2 women graduate per year). This shows how CE is a male dominated field in Chile, resembling the current status of this discipline in the US and other countries. Regarding faculty members composition, the CE program consists of 29 instructors, of which 24.1% (n=7) are women and 75.9% (n=22) are men.

*Participants*

For this focus group, we invited current female CE undergraduates by reviewing the list of enrolled female students via email. For the Group of Students (GS), we had a total of three active female students from the CE program (S1, S2 and S3), ages between 21 and 27 years. They were at different stages of the degree program: 1st , 3rd and final year of study. Two of them had a direct family member linked to the construction industry.

Former students of the CE program were contacted directly by telephone through the department support system, who is also one of the authors of this research. The Group of Alumni (GA) consisted of three former CE students (A1, A2 and A3), ages between 26 and 27 years. One had a direct family member linked to the construction industry. At the time, they were working within the CE discipline, holding positions as Quality Manager, Project Proposal Engineer, and Engineering Administration Assistant.

We reached out personally to each female faculty member of CE to invite them to participate in this focus group. Finally, Group F (GF) consisted of 4 CE female faculty members (F1, F2, F3 and F4), ages between 37 and 48 years, with teaching experience of ranging between 10 and 20 years. The faculty members hold degrees in architecture, civil engineering, and two in civil construction engineering. Their current duties included department chairs, instructional and research faculty members. In order to protect participants anonymity, we provided a robust background on participants, but we will not use their names.

In total, the focus group consisted of a total of 10 women who are involved in CE as current or former students or faculty members. The objective of this study was to design the focus groups

in a way in which each one would reflect a broad spectrum of views and perceptions of women directly linked to the CE degree program, albeit in different forms.

*Focus group facilitation*

The group sessions were run by two researchers. The first has extensive experience in educational research and acted as session facilitator. The second was the academic secretary of the CE program and assumed the role of observer and assistant to oversee the recordings, logistics and provision of materials, as well as to take notes on participant input. We hosted three separate sessions, having each of the groups participating separately. Sessions that involved Groups S and F were conducted face-to-face, while the Group A session was held via Zoom ®. For the face-to-face session, we provided coffee, biscuits and other food for the attendees. In both formats, participants were formally welcomed and then we introduced the dynamics and objectives of the sessions. Then we proceed to ask them to read and sign the informed consent document as part of the ethical framework of the research, which included consent to have the session video recorded by the researchers.

On completion of the three group sessions, the observer prepared a report detailing participant data, the date and duration of each session, and the impressions of the researchers on each group (i.e., the attitude and behavior of participants), among others. The recordings were prepared for transcription and subsequent analysis.

*Group session protocol*

For the group sessions, we implemented an adaptation of Widdicks protocol [16]. We introduce the stages below and specify how it was adapted for each of the three participant groups.

1. *Presentation:* Each participant was provided with paper and pencils, and asked to compose a short presentation, in which they were to describe themselves and their background in construction in three minutes. We provided some prompts to help them in this process, including: Why did you decide to study this degree program? (All groups); Does your family have a background in construction? (All groups); Have you ever had any experience in the field of construction? (Group S); What has your career path in construction been like? (Groups A and F). After five minutes, each participant read their presentation aloud.
2. *Personal definition of sense of belonging:* Participants were asked to write down their own definition of a sense of belonging. They were told that this could be done using different phrases or examples of moments, situations or circumstances that could illustrate the concept. After three minutes, each participant shared their definitions, to conclude this exercise, the facilitator summarized their definitions.
3. *Experiences of not belonging:* Participants were given a block of sticky notes, each participant had a different color, and asked to write down experiences they could remember in which they felt like they did not belong using one sticky note per experience. For Group S, their experiences were related to the context of their undergraduate program; for Group A, their

current work environment; and for Group F, as faculty members in CE and as industry employees. After ten minutes, participants were asked to share their experiences with the group.

4. *Experiences of belonging:* Participants were required to write down the experiences they could remember in which they felt like they belonged, again using the sticky notes. We continued to use the same contexts for each of the groups as stated in their experiences of not belonging. After ten minutes, participants were asked to share their experiences with the group.
5. *Categorization of positive and negative experiences:* Participants were asked to use the sticky notes they created in stages 3 and 4 to arrange their experiences into two categories identified on a flipchart. The facilitator explained they wanted to use their individual experiences to find categories in common. This required for the experiences to be read out loud.
6. *Identify solutions to improve sense of belonging:* Participants were asked to write down on a sheet of paper the five main categories that emerged from stage 5 and propose solutions for each one. After 10 minutes the solutions were shared among the group.
7. *Implement solutions in the CE degree program:* Participants analyzed how the solutions discussed in stage 6 could be applied to the CE education context.
8. *Identify high-priority solutions:* Participants were asked to select the three proposed solutions that they considered most relevant from the previous stage and to explain their selection process.

The information collected in physical form (sticky notes and flipchart) was transferred to digital format using Microsoft Excel and Word files. Data analysis was carried out by the researchers, who used the qualitative analysis software NVivo ® to support the coding process. Therefore, the categories that we will be presenting are not necessarily related to the ones that the participants discussed during the focus group.

**Results**

This section outlines the results obtained from the three focus groups. We present the results by exploring first the sense of belonging defined by the participants (responding to RQ1), then the categories developed for the positive and negative experiences (RQ2, RQ3), finally a section exploring the solutions proposed by participants to improve their experiences both in the academic and workplace environment (RQ4). We would like to emphasize how the prompts were done to each of the groups of participants separately, and yet the responses showed similar themes across their different levels and types of experiences as women in CE (undergraduate students, alumni working in CE field, faculty members in a CE program with experience in the field).

*Sense of belonging*

During the initial stages of the group sessions, participants described their personal definitions of a sense of belonging. Their examples and points raised were categorized utilizing the NVivo software ® in order to generate a word cloud, shown in Figure 1.


Figure 1. Word cloud to conceptualize sense of belonging according to study participants (NVivo ®).

According to participant responses, the sense of belonging is fueled by positive feelings of self-discovery, recognition by others, and feeling at ease in any given place, work setting or group. They noted that satisfaction of being part of something greater and being empowered and appreciated by your peers, i.e collaborative work and a recognition that your role is important while understanding that you also empower others, all help to improve a sense of belonging. They also commented that forming part of a whole, feeling that you fit in with the rest and that your role is worthwhile and respected within the context of achieving goals and objectives heightens your sense of belonging.

In the following sections, we observe how these participants then engage in describing their positive and negative experiences in CE that either support their sense of belonging or impedes it.

*Positive experiences to have impacted the sense of belonging of participants*

In total, GA produced nine stickers sharing their positive experiences of sense of belonging, while GB produced nine ideas, and finally, GC produced 16 stickers.The experiences of all three groups of participants were categorized into internal and external and subcategories were generated, shown below.

*Skills and knowledge (Internal).* Participants discussed how having an awareness of their skills and knowledge has made them feel they belong. For example, both S1 and A3 mentioned that

passing their subjects with high grades made them feel that they really were where they were supposed to be. Regarding skills, S3 said *"I feel that I really belong on my program because I have the ability to lead a group without having to mistreat or belittle anyone."* While S1 stated that *"one of the moments in which I felt most a part of my program was when I was part of the student association, I felt a real sense of pride and I was able to become a leader."* On the other hand, the faculty members mentioned that sharing their knowledge through teaching and training new professionals in the field increases their sense of belonging.

*Validation and recognition (External)*. Among the external elements that promote a sense of belonging, all three groups of participants recognized peer validation and the explicit recognition of their knowledge, work and skills as a relevant component. This validation and recognition would be coming from faculty members, students, leaders and classmates, and colleagues. For example, S1 noted that she feels a sense of belonging *"when I receive extensive feedback or constructive criticism."* Likewise, A2 stated that *"...the fact that I'm given more important assignments, I'm trusted more and have been told that I'm good at certain things, that the quotes I have are good..."* Similarly, A3 mentioned *"when you do things well, receive recognition for your work, and are congratulated in front of others, it's really rewarding..."* The group of faculty members claimed to feel a sense of belonging *"when my students greet me and thank me for what they are getting out of my classes,"* and *"when I was invited to join a prestigious business and construction magazine as an expert columnist"* (F1). On the other hand, F3 remarked on feeling a sense of belonging *"when a particular job or project finishes and the client is happy with the work done,"* while F4 commented, "*I feel I really belong because of all the different job opportunities that have come my way."*

*Collaboration and socialization (External)*. The social and collaborative part is a prominent and cross-cutting element for all three participant groups. Having the possibility to socialize in an organic and constructive way with peers, whether it is in class or in the workplace environment, is an important component of their sense of belonging. For example, one S2 stated this is the case *"when students and construction professionals speak the same language, a real conversation can be had,"* in reference to instances in which there are no gender or knowledge-level biases and whereby a CE student can socialize with construction professionals because they are able to speak the same language. In addition, A2 mentioned *"when you're integrated into the team at work, you're considered for meetings, you're made to feel part of the team, colleagues ask for your opinion, etc."* Following the same line of thought, F4 noted that her sense of belonging grows when she *"meets the other women in my company and feels part of a group of expert professionals."*

*Negative experiences that have impacted the sense of belonging*

In total, GS produced eight stickers sharing their negative experiences of sense of belonging, while GA produced 11 ideas, and finally, GF produced 12 stickers. The analysis of all three

groups of participants distinguished the experiences between internal and external. Internal experiences relate to elements of the personality, preferences and personal expectations of participants, *self-confidence*. In contrast, external experiences are elements that depend on the actions of others or that stem from the surrounding environment, i.e., elements that one cannot control oneself. There were three categories within the external experiences: *University and work environment, Social environment, and Support and collaboration.* We elaborate on each of these categories.

*Self-confidence (Internal)*. Participants discussed how, during certain points in their degrees or careers, they have felt a lack of confidence to participate. In this respect, S1 stated "*I find that I lack the self-esteem needed to know that what I want to say is right or wrong, and that if I say what I think, maybe nobody will reply. But fear is also part of it, and sometimes it comes from the instructors and their reactions, where (and this has happened to me) they treat you like a fool in front of the entire class..."* Another element to undergo discussion was how their confidence has been undermined by comments from other people telling them that the degree program was only for men, and that, consequently, they harbored anxieties about not being respected by their male peers from the very beginning of their career. For example, S3 commented, *"it was the fear of meeting male-only course mates, I'd think things like 'they're not going to respect me, they're not going to take me seriously' and that was a fear I had right from the beginning of my degree, and it's been going on ever since..."* Finally, we observed participants discussing how doubts about their own knowledge levels have particularly undermined their confidence and sense of belonging. As such, A3 explained: *"I question myself about having studied construction, since it involves so many different challenges, including having to know a lot of technical things which I don't always know..."* Similarly, A2 said *"I often want to ask something that is really stupid or that I should know, and I always have that insecurity and uncertainty...*"

*University and work environment (External)*. The environment in the classrooms for CE students, including instructors and students, is a factor that participants find stressful and demotivating. Students expressed feeling out of place since male faculty tends to center their teaching towards the male students. For example, S2 noted *"like when professors refer more to men and say things like: no, don't worry (women), this needs to be done by the boys."* Participants not only talk about how faculty members use or lack the use of inclusive language, but also how they have different expectations of students depending on their gender. For example, they will refer to how men are able to reach certain high positions in their career, and how they face difficulties through it, neglecting to include women in that description which can suggest they wouldn't be able to achieve the same goals. Findings also show that faculty members often treat female students as less capable than their male peers and their ideas are not as valued in class. Male students, on the other hand, have a code of conduct that demotivates female students, which, according to the latter, makes them feel afraid that they will not be respected. For example, students share their awareness of living in a misogynistic society, which

they take for granted others are aware of. They go and share how it is common for male faculty to share statements in the way of *"I should not say this because there are women present but…"* followed by mockery comments that belittle women. The students recognize how this is unnecessary and how this directly affects them, women students in the classroom, since it is a form of rejection to their presence. This toxic masculinity is not only coming from male faculty but also from their male peers, where students recognize how trying to collaborate with their male classmates was considered a loss of time due to their negative interactions at the beginning of their program and they notice how they have developed coping mechanisms by now. From the female faculty members perspective, they report having experienced male students belittling their role in the classroom and creating a disruptive environment.

*Social environment (External).* Participants discussed their role in society and how there is a general prevalence of gender bias against women studying a CE degree. They consider that these gender biases and stereotypes create demotivate them to persist in the program. For example, S3 noted *"there was a time when I was hesitant about enrolling in this program because they (people close to me) would always tell me: ah, but that's a career for men, when you go to work on a construction site they'll just want to mess around with you in any way they can."* They also consider that socialization in the classroom can also be challenging. All three participant students reported recognizing male students have certain routines or ways of doing things that they don't necessarily approve of. Therefore, their sense of belonging is compromised given their differences and may not see it changing in the future.

*Support and collaboration (External).* The main two factors highlighted here are individualism and lack of leadership, mostly by alumni and faculty members. Participants discussed the high levels of competition in the field of construction, which generate an individualized form of work. This makes them feel that they do not form part of a tangible whole and that they do not share the same goals as the rest of their colleagues. We can notice how this goes against their definition of sense of belonging where being part of a group that shares common goals and works together towards achieving those goals is critical. Alumni and faculty members also discussed the hostile environment in the construction industry, which includes verbal abuse and, if you are a woman, getting your ideas and decision-making process undervalued and disregarded. Furthermore, participants mentioned that women generally hold positions as heads of department in the academic setting, while senior management positions in the field are occupied by men. As shared by F4, the genderization of duties is shown by this tendency of upper management, *"The desk work that the manager doesn't do, the head of department has to do."*

*Collaborative solutions to strengthen the sense of belonging*

Participants proposed several high-priority solutions to improve women's sense of belonging in the CE sector. By analyzing the solutions proposed by the three groups of women, there are four

crucial items to act on: 1) create inclusive environments; 2) innovate educational strategies; 3) encourage recognition of achievements and fulfillment of objectives; and 4) improve the self-confidence of women in the field of construction. The meaning given by the participants to each proposed solution is described below.

*Create inclusive environments.* Participants in all three groups (students, alumni, faculty) independently considered that in order to improve the sense of belonging of women in the construction industry, it is necessary to generate initiatives that promote inclusion as well as collaboration. According to the participants, collaboration fosters the creation of interpersonal bonds, increases empathy among the people in the group, enhances effective communication, and develops soft skills. These elements sensitize group members (whether students or employees), and the possibility and opportunity to maximize the presence and participation of women exist, thus generating a more inclusive environment. In addition, participants mentioned the importance of holding workshops and awareness-raising talks on gender and inclusion issues.

*Innovate educational strategies.* Participants from the Group of students and faculty members independently agreed on the need for students to have field experience as part of their training so that when they graduate, they will be more confident in their knowledge and skills and will not simply be entering an environment that is alien and unfamiliar. Furthermore, they discussed the possibility of senior students mentoring more junior ones to share advice and experiences. Finally, certain participants from these groups discussed how comprehensive and constructive feedback could help to improve a sense of belonging. Participants from the group of students referred to the need for teaching professionals to conduct a formative evaluation of students, with extensive feedback on areas in which the student can improve. This strategy aims to ensure that students are better prepared and feel more confident in their skills and knowledge.

*Encourage recognition of achievements and fulfillment of objectives.* The recognition of achievements is a theme that was primarily touched on by groups of alumni and faculty members; thus, they were the ones who generated ideas around proposing related solutions. Participants mentioned that achievement is encouraged through recognition. They explained the importance of valuing innovative ideas, celebrating achievements, and rewarding or giving due recognition to good work. According to the participants, this entails having the support of peers and leaders.

*Improve the self-confidence of women in the field of construction.* The group of alumni were the ones who primarily addressed the issue of self-confidence, their insights were more personal than academic or work-related. For example, one of the proposed solutions was to adopt structured time-management habits to prioritize tasks according to their importance so that workload does not exceed capabilities. In this way, they would avoid disappointments and would not feel unable to fulfill the tasks delegated. In addition, participants mentioned the importance of staying active

in terms of academic preparation since knowledge yields power and confidence. Finally, participants mentioned how crucial it is for every woman in construction to have a positive attitude and work on herself so that she becomes aware that although men dominate the field, women are equally capable. One suggestion was to devise a strategy to identify a mentor-like figure (perhaps a colleague, ex-colleague, or former university classmate) who knows the field well and who would be able to act as a means of support, someone to talk to and someone who could help resolve any difficulties or doubts.

**Discussion**

This qualitative study, based on group sessions held with female students, alumni, and faculty members from the CE program, allowed us to explore how they define a sense of belonging within CE, categorize their experiences, and propose collaborative solutions subsequently. It is relevant to reiterate how the discussions were held separately by each of the participants group, and yet the solutions provided showed shared thematic across the participants. Therefore, the findings from this study reiterates a shared experience amongst women in CE at their different stages of involvement in this field.

The participants' conceptualization of the sense of belonging in the field of construction highlighted two sources of elements where their sense of belonging comes from, internal and external factors. As shown in Figure 2, the combination of these internal and external factors show how the participant women of this study define their sense of belonging in a CE environment. Therefore, their positive experiences are related to the instances in which one or more of these factors were present while the negative experiences are instances where one or more of these factors were missing or denied.

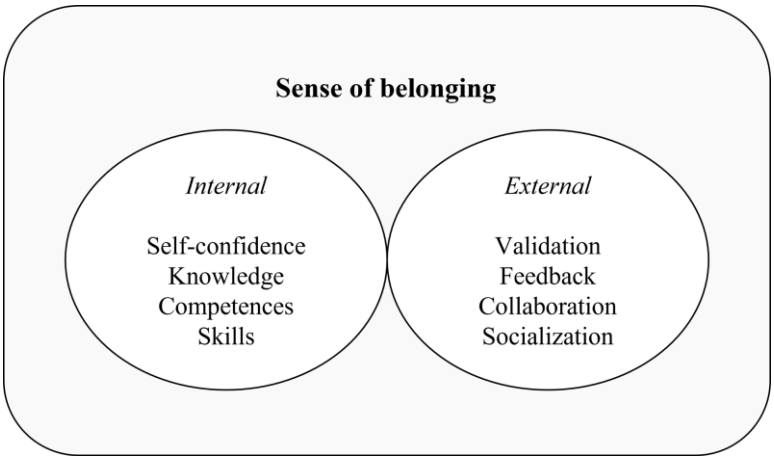


Figure 2. Internal and external elements that influence the sense of belonging. Categorization based on focus groups with three groups of participants. *(In-house research)*.

The internal and external factors are deemed important by participants for improving their sense of belonging. The internal factors refer to the person’s emotional and psychological

characteristics while the external elements steem from their surrounding environment. While not all of the factors need to be present at once, their general existence or presence increases the sense of belonging of women in the field of construction. For example, proposing active and collaborative learning strategies will positively impact student learning, skills and competencies. In this regard, Ballen et al. [18] report that holding classes in which student-centered learning activities are implemented, such as collaborative activities, leads to greater student confidence in their scientific ability and a greater sense of social belonging within the classroom in general.

The participants in this study indicated that it is important to them that teaching strategies promote collaboration and discussion in class. Accordingly, Kovarik, Robinson, & Wenzel [19] state that when students engage in collaborative activities, they are more likely to form new friendships with their classmates, both in lectures and in the laboratory. In turn, this encourages socialization and can result in students identifying study partners with whom to connect outside of class time. In addition, collaborative work helps people to practice verbal and written communication skills. All this enhances self-efficacy and sense of belonging. Related to this, participants suggested that the frequency of field activities should be increased to help students gain skills and experience in the real world of work. Lan Oo, Feng, & Teck-Heng Lim [20] stress that one of the causes of early dropout among women entering the world of work in the construction sector is precisely a lack of experience in the industry.

The need to create inclusive environments is a high priority need identified by this . The environment in the classroom as well as in the workplace is a stressful one for female participants due to the masculinized culture that prevails in the field of construction. Indeed, gender discrimination is experienced in both environments. In line with the findings of this study, other authors report how higher management positions are primarily occupied by men. They mention the practice by which companies assign women to smaller and lower-cost projects, which limits their ability to access other, larger opportunities [21]. This type of discrimination delays the career path of women and “can prohibit a woman’s chances of breaking the glass ceiling in the construction industry as a project manager” [21, p.2], which is recognized both by alumni and experienced faculty members in this study. Part of the masculinized culture of the construction industry relates to the hostile environment experienced by the women who participated in this study, in both the academic environment as well as in the industry.

Regis et al. [3] report that, in general, women working on a construction site tend to feel less comfortable than men, indicating difficulties, a lack of respect and security during working hours. These types of feelings and behaviors tend to make women attempt to change their "feminine" attitudes and behavior to fit in with the culture of their male colleagues. However, this only negatively affects women since it affects their identity and sense of belonging [14]. The participants in this study reported experiencing hostility and harassment at work (non-sexual). However, they coped with these situations by demonstrating their abilities, becoming more self-

confident, and relying on a supportive leader. Lan Oh et al. [20] suggest that, in light of the CE drop out rates, women in the early stages of their careers need the support of mentors in order to retain their positions.

Finally, validation of the environment and recognition of achievements are discussed as important elements in improving women's sense of belonging in construction. Li & Singh [22] claim that self-efficacy can be shaped by verbal encouragement from others, so it is important to promote validation and recognition of achievements and goals as a means through which to influence the self-efficacy of others positively. Whitcomb et al. [5] report that their perceived recognition informs the identity of a person who forms part of a specialized group by teaching staff, assistants, peers, and family members, also known as "external identity." The perceived recognition, or external identity, explains a student's self-efficacy and interest in distinct fields of study. Their belief in how others see them directly influences how that student sees him or herself.

**Implications**

The motivation behind this research is to help guide the design of efficient interventions with which to reduce gender segregation in the academic and work environments of the field of construction. Based on the findings of this investigation, these are some of the recommendations we can provide to improve the participation of women in CE, in both the academic and professional settings.

Department chairs are responsible for training their teaching staff in the use of student-centered learning strategies in order to promote collaborative work, peer interaction, and student learning. Therefore, we consider there should be an emphasis from the Department level at universities to train teaching and administrative staff about the importance of the use of inclusive language in the classroom to improve their sense of belonging. Also, we consider similar actions should be taken in the industry by construction managers.

In order to enhance women’s self-perception, identity, and sense of belonging in CE while pursuing their degree, universities should increase field activities. This would enable students to access the local field of work and embed them into their career path. Furthermore, we recommend encouraging mentoring activities for all three groups of participants given their shared experiences. Alumni and faculty members are more experienced and could serve as positive mentors and role models for students currently enrolled in the CE program. Even final year students may be able to provide useful tools to their more junior counterparts. Either way, participants expressed that a good mentor and leader makes a big difference in how they feel within the field of construction.

## Conclusion

The results of this research indicate a need to generate initiatives with which to help improve the sense of belonging of women related to the CE program as current students, alumni working in CE, or faculty members teaching in the CE program. Therefore, the stakeholders are those who are involved in the CE program as current students and faculty members of the CE program, and local industry who uses the services of CE professionals. We consider the testimonies supporting informed actions from all of the stakeholders to improve the sense of belonging of women in CE such as create inclusive environments; innovate educational strategies; encourage recognition of achievements and fulfillment of objectives; and improve the self-confidence of women in the field of CE. While these outcomes might have been explored in the past, we have observed how prevalent these issues are since the categories discovered were shared separately by each of the group of participants pointing to very similar experiences at different points of their CE profession.

Furthermore, it is necessary to overcome gender stereotypes that associate competence with men more than with women, which is not exclusive to the CE field but it is definitely recognized by each of the three groups of participants as prevalent. It is critical to generate awareness-raising initiatives for women on the CE degree program, to enable them to develop the tools and skills required to face the type of environment found in the CE industry and to support their grit through their profession while looking to change the current climate. Simultaneously, men need to be trained and sensitized on gender and inclusion issues for them to take actions as individuals and as a group.

The main limitation of this study is methodological, as it consists of a small sample size, a common trait in qualitative research. Several women that matched the required characteristics of study participants were invited, but only a small number voluntarily agreed to take part. Moreover, no information was collected regarding their ethnicity, race, sexual orientation, etc., which would have broadened the study and helped to explain the sense of belonging of the participants in greater depth.

In the future, the objective is to conduct interventions in the classroom in order to investigate how sense of belonging changes as a result of these interventions. The planned interventions include increasing student-centered activities and promoting inclusion in the classroom through awareness-raising workshops, among other similar initiatives. In addition, it is the intention of the authors of this study to design a pilot mentoring program with which to empower women CE students.

**Acknowledgements**
The authors would like to acknowledge the leadership and financial support of the School of Engineering of the Universidad Andres Bello, Chile. They also thank the Educational and Academic Innovation Unit (UNIDA) for its mentoring and guidance in developing scientific articles in higher education research.

**References**
[1] G. Godoy, What is the current reality of women in Chile in the workplace?, April 3rd, 2022. [online]. Available in: https://www.ine.gob.cl/prensa/2022/03/04/cu%C3%A1l-es-la-realidad-actual-de-las-mujeres-en-chile-en-el -%C3%A1mbito-laboral

[2] A. Hasan, A. Ghosh, M. N. Mahmood, and M. J. Thaheem, "Scientometric Review of the Twenty-First Century Research on Women in Construction", *J. Manage. Eng.*, vol. 37, n.º 3, p. 04021004, may 2021, doi: 10.1061/(ASCE)ME.1943-5479.0000887. [Online]. Available in: https://ascelibrary.org/doi/10.1061/%28ASCE%29ME.1943-5479.0000887.

[3] M. F. Regis, E. P. V. Alberte, D. D. S. Lima, and R. L. S. Freitas, "Women in construction: shortcomings, difficulties, and good practices", *ECAM*, vol. 26, n.º 11, pp. 2535-2549, nov. 2019, doi: 10.1108/ECAM-09-2018-0425. [Online]. Available in: https://www.emerald.com/insight/content/doi/10.1108/ECAM-09-2018-0425/full/html.

[4] M. Silva and A. Dominguez, "Women in Construction Engineering: Improving the Students' Experience throughout their Careers", in *2021 ASEE Annual Conference*, jun. 2021 [Online]. Available in: https://peer.asee.org/38106

[5] K. M. Whitcomb, A. Maries, and C. Singh, "Progression in Self-Efficacy, Interest, Identity, Sense of Belonging, Perceived Recognition and Effectiveness of Peer Interaction of Physics Majors and Comparison with Non-Majors and Ph.D. Students", *Res Sci Educ*, sep. 2022, doi: 10.1007/s11165-022-10068-4. [Online]. Available in: https://link.springer.com/10.1007/s11165-022-10068-4.

[6] S. Banchefsky, K. L. Lewis, and T. A. Ito, "The Role of Social and Ability Belonging in Men's and Women's pSTEM Persistence", *Front. Psychol.*, vol. 10, p. 2386, oct. 2019, doi: 10.3389/fpsyg.2019.02386. [Online]. Available in: https://www.frontiersin.org/article/10.3389/fpsyg.2019.02386/full.

[7] C. Delahanty and J. Silverman, "Creative Self-Efficacy of Undergraduate Women Engineering Majors", in *2021 ASEE Virtual Annual Conference Content Access Proceedings*, Virtual Conference, jul. 2021, p. 36877, doi: 10.18260/1-2--36877 [Online]. Available in: http://peer.asee.org/36877.

[8] R. M. Marra, K. A. Rodgers, D. Shen, and B. Bogue, "Leaving Engineering: A Multi-Year Single Institution Study", *Journal of Engineering Education*, vol. 101, n.º 1, pp. 6-27, ene. 2012, doi: 10.1002/j.2168-9830.2012.tb00039.x. [Online]. Available in: https://onlinelibrary.wiley.com/doi/10.1002/j.2168-9830.2012.tb00039.x.

[9] K. L. Lewis, J. G. Stout, S. J. Pollock, N. D. Finkelstein, and T. A. Ito, "Fitting in or opting out: A review of key social-psychological factors influencing a sense of belonging for women

in physics", *Phys. Rev. Phys. Educ. Res.*, vol. 12, n.º 2, p. 020110, ago. 2016, doi: 10.1103/PhysRevPhysEducRes.12.020110. [Online]. Available in: https://link.aps.org/doi/10.1103/PhysRevPhysEducRes.12.020110.

[10] C. Mooney and B. A. Becker, "Sense of Belonging: The Intersectionality of Self-Identified Minority Status and Gender in Undergraduate Computer Science Students", in *United Kingdom & Ireland Computing Education Research conference*., Glasgow United Kingdom, sep. 2020, pp. 24-30, doi: 10.1145/3416465.3416476 [Online]. Available in: https://dl.acm.org/doi/10.1145/3416465.3416476.

[11] A. Fink, R. F. Frey, and E. D. Solomon, "Belonging in general chemistry predicts first-year undergraduates' performance and attrition", *Chem. Educ. Res. Pract.*, vol. 21, n.º 4, pp. 1042-1062, 2020, doi: 10.1039/D0RP00053A. [Online]. Available in: http://xlink.rsc.org/?DOI=D0RP00053A.

[12] D. Wilson, D. Jones, F. Bocell, J. Crawford, M. Joo Kim, N. Veilleux, T. Floyd-Smith, R. Bates, and M. Plett, "Belonging and Academic Engagement Among Undergraduate STEM Students: A Multi-institutional Study", *Res High Educ*, vol. 56, n.º 7, pp. 750-776, nov. 2015, doi: 10.1007/s11162-015-9367-x. [Online]. Available in: http://link.springer.com/10.1007/s11162-015-9367-x.

[13] L. Benson, C. Bolding, J. Ogle, C. McGough, J. Murphy, and R. Lanning, "Engineering Students' Perceptions of Belongingness in Civil Engineering", in *2019 ASEE Annual Conference & Exposition Proceedings*, Tampa, Florida, jun. 2019, p. 32737, doi: 10.18260/1-2--32737 [Online]. Available in: http://peer.asee.org/32737.

[14] J. Elliott and C. Lopez Del Puerto, "Self-Efficacy, Motivation, and Locus of Control Among Male and Female Construction Management Students", in *2014 ASEE Annual Conference & Exposition Proceedings*, Indianapolis, Indiana, jun. 2014, [Online]. Available in: http://peer.asee.org/23010.

[15] L. Debs and B. R. Kota, "Gender Differences in Construction Management Students' Sense of Belonging," in *ASEE Annual Conference and Exposition*, Conference Proceedings, 2021, no. 32440. Available in: https://peer.asee.org/37220

[16] M. E. Andrews, M. Borrego, and A. Boklage, "Self-efficacy and belonging: the impact of a university makerspace", *IJ STEM Ed*, vol. 8, n.º 1, p. 24, dic. 2021, doi: 10.1186/s40594-021-00285-0. [Online]. Available in: https://stemeducationjournal.springeropen.com/articles/10.1186/s40594-021-00285-0.

[17] K. Widdicks, A. Ashcroft, E. Winter, and L. Blair, "Women's Sense of Belonging in Computer Science Education: The Need for a Collective Response", en *United Kingdom and Ireland Computing Education Research conference.*, Glasgow United Kingdom, sep. 2021, pp. 1-7, doi: 10.1145/3481282.3481288 [Online]. Available in: https://dl.acm.org/doi/10.1145/3481282.3481288.

[18] C. J. Ballen, C. Wieman, S. Salehi, J. B. Searle, and K. R. Zamudio, "Enhancing Diversity in Undergraduate Science: Self-Efficacy Drives Performance Gains with Active Learning",

*LSE*, vol. 16, n.º 4, p. ar56, dic. 2017, doi: 10.1187/cbe.16-12-0344. [Online]. Available in: https://www.lifescied.org/doi/10.1187/cbe.16-12-0344.

[19] M. L. Kovarik, J. K. Robinson, and T. J. Wenzel, "Why Use Active Learning?", en *ACS Symposium Series*, vol. 1409, T. J. Wenzel, M. L. Kovarik, y J. K. Robinson, Eds. Washington, DC: American Chemical Society, 2022, pp. 1-12 [Online]. Available in: https://pubs.acs.org/doi/abs/10.1021/bk-2022-1409.ch001.

[20] B. Lan Oo, X. Feng, and B. Teck-Heng Lim, "Early career women in construction: career choice and barriers", *IOP Conf. Ser.: Mater. Sci. Eng.*, vol. 601, n.º 1, p. 012021, ago. 2019, doi: 10.1088/1757-899X/601/1/012021. [Online]. Available in: https://iopscience.iop.org/article/10.1088/1757-899X/601/1/012021.

[21] A. J. Perrenoud, B. F. Bigelow, and E. M. Perkins, "Advancing Women in Construction: Gender Differences in Attraction and Retention Factors with Managers in the Electrical Construction Industry", *J. Manage. Eng.*, vol. 36, n.º 5, p. 04020043, sep. 2020, doi: 10.1061/(ASCE)ME.1943-5479.0000808. [Online]. Available in: https://ascelibrary.org/doi/10.1061/%28ASCE%29ME.1943-5479.0000808.

[22] Y. Li y C. Singh, "Effect of gender, self-efficacy, and interest on perception of the learning environment and outcomes in calculus-based introductory physics courses", *Phys. Rev. Phys. Educ. Res.*, vol. 17, n.º 1, p. 010143, jun. 2021, doi: 10.1103/PhysRevPhysEducRes.17.010143. [Online]. Available in: https://link.aps.org/doi/10.1103/PhysRevPhysEducRes.17.010143.