

## **Exploring Self-Efficacy and Sense of Belonging in Engineering: The Role of Institutional Support**

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# Exploring Sense of Belonging and Self-Efficacy in Engineering: The Role of Institutional Support

## Abstract

Numerous studies have explored the impact of self-efficacy and a sense of belonging on STEM career selection and persistence, fostering identity development. Institutional support is pivotal for STEM students' academic progression and persistence. Such support includes educational guidance, mentorship, and cultural and athletic engagement. Evidence shows that these services enhance students' sense of belonging and motivation and influence their self-efficacy. This is particularly vital for first-generation college students. With its substantial first-generation and economically disadvantaged student population in engineering education, it is crucial to respond to this situation regarding self-efficacy, sense of belonging, and students' perceptions of access to institutional support. This research article explores the connection between students' sense of belonging, self-efficacy, and perceived institutional support in a private institution in Chile. We are particularly focused on unraveling how the university's services intersect with these socio-cognitive aspects, and this interest is amplified by the fact that a significant portion of the student body comprises first-generation university attendees. Our study encompasses 321 students pursuing various engineering majors at this university, where 60% of the student population belongs to the first-generation category. We analyzed survey responses assessing sense of belonging, self-efficacy, and institutional support. The survey explores three dimensions: 1) general belonging, 2) belonging in educational interactions, and 3) self-efficacy, each with eight items. The survey covers various aspects of the institution's student services, including psychological support, academic planning, tutoring, health and well-being services, sports, and supplementary areas like leadership, diversity, gender, and participatory meetings. It totals 29 items. Respondents expressed their views using a 5-point Likert scale, from "strongly agree" to "strongly disagree." Our findings reveal that all surveyed students exhibit a strong sense of belonging (both in general and within educational interactions) and self-efficacy. Notably, psychological support displays a significant and positive correlation with a sense of belonging, encompassing both general and interactional aspects. Furthermore, the sports and supplementary areas service exhibits a moderate and favorable correlation with the general sense of belonging. Conversely, the remaining services display relatively weak yet positive correlations with a sense of belonging (both in general and within educational interactions). Self-efficacy, on the other hand, maintains positive correlations with academic services, albeit of a weak or negligible nature, indicating a lack of a significant relationship between student services and student self-efficacy. These findings provide valuable insights into potential avenues for crafting institutional initiatives. These initiatives aim to foster students' sense of belonging and connection with the institution and bolster a significant psychological element crucial for academic persistence and advancement: self-efficacy. This is especially relevant in a school of engineering with a substantial population of first-generation students.

**Keywords:** *Institutional support, first-generation students, self-efficacy, sense of belonging*

## Introduction

In university education, the daily contextual factors that students encounter are crucial in shaping their academic and personal growth. Educational institutions are responsible for providing services that bolster students' self-efficacy and foster a sense of belonging within their chosen disciplines and the wider academic community [1-3]. Empirical studies by

Hanauer [4], Kaufman et al. [5], and Whitcomb et al. [6] have established that strong self-efficacy and a profound sense of belonging significantly enhance students' persistence in their chosen career trajectories. This relationship is especially evident in Science, Technology, Engineering, and Mathematics (STEM), where a heightened sense of belonging and elevated self-efficacy are linked to superior academic achievements [7-8].

Educators play a pivotal role in this dynamic, employing student-centered pedagogical approaches that include group work, reflective exercises, peer discussions, and constructive feedback. These methods, as highlighted in the works of Ballen et al. [9], Emigh et al. [10], Kalender et al. [11], Kramer & Kusurkar [12], and Shaffer et al. [13], are instrumental in enabling students to socialize with peers and develop strong support networks within their academic environments. Such methodologies enhance learning experiences and contribute significantly to developing a supportive and inclusive educational atmosphere.

Institutional support represents multifaceted initiatives dedicated to disseminating information that elevates students' academic performance and enhances their educational experience. This support system is crucial in providing students access to essential resources that underpin academic success. It involves a proactive approach to monitoring and guiding students' academic progress and development. Furthermore, this support extends to nurturing content-independent and content-dependent skills, which are fundamental to achieving academic excellence [14].

Additionally, institutional support, encompassing psychological support, tutoring, academic monitoring, sports services, and other extracurricular activities, plays a significant role in students' academic journey. It contributes to their satisfactory progression through their chosen study programs and enhances student retention and persistence. By addressing academic and non-academic needs, these support systems ensure a more holistic development of students. This comprehensive approach to student support is crucial in preparing students effectively for their future professional endeavors and boosting their overall performance [15].

Taimoory et al. [16] investigated how involvement in STEM activities impacts students' views on peer academic support in these fields. The findings indicated a notable link between active participation in STEM and the depth of connections students feel with their peers in these areas. The study particularly emphasized the positive effect of peer interactions in engineering on fostering a sense of belonging among students. This aspect of belonging, as highlighted by [16], is vital for student well-being and academic success. The study's outcomes point to the crucial role of peer support in STEM educational settings, underscoring the need for robust institutional support systems that facilitate such meaningful peer engagements and interactions.

The topic of institutional support for university students, particularly those majoring in STEM fields, has been widely explored. The predominant findings indicate that these students often require support in multiple areas, notably emotional and psychological. This need stems from commonly experienced feelings of anxiety, loneliness, and frustration [17]. These challenges are further amplified among students who are part of minority groups, including those defined by gender, race, ethnicity, or status as first-generation students [18].

First-generation students (FGS) are the first in their families to access university education. This group often faces unique challenges and experiences distinct from their peers whose

parents or relatives have university-level professional careers, also known as continuing-generation students [19, 20]. Research on FGS has focused on several key aspects, including social and academic types, as FGS may struggle to adapt to the university environment due to a lack of "institutional wisdom" that other students inherit from families experienced in the social and academic dynamics of a university context [21, 22]. Another challenge for FGS is financial, as these students generally come from families with fewer economic resources, potentially increasing stress related to tuition and living expenses [22].

Regarding family factors, students often face intense pressure to succeed because their families view educational success as a means to elevate the family's economic and social status [23, 24]. In the academic context, interactions within the university influence factors associated with FGS's sense of belonging. Studies have reported that these students struggle to feel part of the university community, as their self-concept is not strengthened due to their family background and low self-esteem [23, 23, 25]. As mentioned at the beginning of this section, this lack of sense of belonging is related to low academic performance, which is a possible cause of dropout. These factors have prompted universities to recognize the need to provide specific resources and support for FGS, including academic tutoring, counseling, mentorship programs, and psychological support [2, 26-27].

To summarize, the research emphasizes the significance of boosting students' self-confidence and a sense of belonging to increase their persistence and success. In particular, universities' support is critical to students' academic and personal growth, particularly in STEM fields. This support is demonstrated through pedagogical methods that prioritize the needs of students and the availability of diverse services that furnish academic and non-academic requirements. Moreover, there is a need to focus on first-generation students who encounter unique obstacles and need additional support to overcome difficulties and make the most of their university experience. In the end, these approaches and resources enhance academic results and equip students with the skills needed to tackle future professional and personal challenges, highlighting the crucial role of educational institutions in shaping competent individuals in a constantly changing society.

This research article delves into the intricate relationship between students' sense of belonging, self-efficacy, and perceptions of institutional support at a large private university in Chile. Our primary objective is to unravel how the university's various services interact with and influence these socio-cognitive aspects of student life. This investigation is mainly motivated by the unique composition of the university's student body, a significant portion of which consists of first-generation students (60%). Understanding this dynamic is crucial for enhancing these students' educational experience and support mechanisms.

In the context of this research and within the institution where it is conducted, five key institutional services are integral to providing support:

1. Psychological accompaniment: This service offers personalized therapy sessions by qualified university psychologists to support students' mental and emotional well-being.
2. Academic tutoring. This service involves group sessions led by experienced senior students. These sessions guide complex course material and problem-solving techniques and address classroom-related queries, facilitating peer-to-peer learning and academic support.
3. Career planning counseling: This service assists students in strategically organizing their course schedules semester by semester. It ensures students progress

appropriately in their academic careers, aligning their course choices with long-term career goals.

4. Health and wellness: This encompasses a range of services promoting physical health and overall well-being. It includes access to nutritional advice and mental health resources, supporting students in maintaining a healthy balance between academic pursuits and personal well-being.
5. Sports and complementary areas: This service offers activities and programs in sports, leadership, diversity, gender studies, and participatory meetings. It enhances students' extracurricular experiences, fosters inclusive community engagement, and develops leadership and interpersonal skills.

In the forthcoming sections, we will present the methodology, detail the research design, describe the sample population, explain the tools used for data collection, and outline the steps taken in data analysis. Subsequently, we will present the results, beginning with the primary descriptive data about the sample and the initial findings, followed by the comparative and correlational analyses. Next, we will delve into the discussion section, where we will interpret the results within the context of existing literature and theory. This section will also explore the practical implications of our findings for educational institutions, focusing on enhancing student support services. Finally, we will conclude by offering a reflective summary of the significance of the study and its contributions to STEM education research.

## **Methodology**

This section describes the research design, data collection instrument, sample selection, and statistical methods used for data analysis.

### *Survey*

The methodology of this study adopts a quantitative, non-parametric approach, employing descriptive and inferential statistical techniques to investigate the relationships between students' familiarity with institutional support services and their sense of belonging and self-efficacy. We administered a validated survey on the sense of belonging and self-efficacy that also included questions concerning the level of knowledge and use of different institutional support services [28]. A Cronbach's Alpha of 0.878 was attained during the validation process. At the same time, a factorial analysis yielded an adjustment of factors to 4 dimensions with a cumulative explanation percentage of 65 % (with a KMO equal to 0.812 and a Barlett's test of sphericity equal to 0.000). The Exploratory Factor Analysis performed in this study was Principal Component Analysis with Varimax rotation. Table 1 shows sample items of each dimension and the corresponding Cronbach's Alpha.

The survey response scale is of the Likert type that starts at 1. Strongly disagree, up to 5. Strongly agree. We included a dimension called "Perceived Institutional Support" with five items. The initial statement for those items was: In my School, it is easy for me to find support services for a) Psychological accompaniment, b) Planning my career with academic counseling, c) Receiving academic tutoring, d) Find health and wellness support services, and e) Get involved in sports and complementary areas (leadership, diversity, and gender, participatory meetings, etc.). For this dimension of "Perceived Institutional Support," the possible response scale of the Likert type included the possibility of answering with 0. *I do not know that service.*

**Table 1.** Sample items by survey dimensions.

| <i>Dimensions</i>                                            | <i>Sample items</i>                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Sense of belonging-interactions</i><br>( $\alpha=0.749$ ) | I feel comfortable asking a teacher for help when I don't understand the subject.<br>If someone does not agree with my ideas, I can find ways and means to get them to change their mind.<br>When I interact with the professors at this university, I feel that they care about my performance. |
| <i>Sense of belonging-general</i><br>( $\alpha=0.827$ )      | I see myself as part of the university community.<br>It has been easy for me to make friends at the School of Engineering.<br>I feel like I really belong in my college career.                                                                                                                  |
| <i>Self-efficacy</i><br>( $\alpha=0.844$ )                   | I can always solve difficult problems if I try hard enough.<br>It is easy for me to stick to my objectives and achieve my goals.<br>I can solve most problems if I put in the necessary effort.                                                                                                  |

Descriptive statistics were used in sample characterization for data analysis. Likewise, non-parametric tests were carried out as there was no normal distribution; chi-square, Kruskal Wallis test, and Spearman's correlations were conducted using the SPSS statistical software.

### *Participants*

The instrument was applied to undergraduate students enrolled in various courses at the School of Engineering of a private Chilean university. From a universe of 2428 students, 369 voluntary responses were received, of which 321 responses were valid. The sample margin of error is 5.10%, with a 95% confidence level.

Of the 321 responses, 15.3% came from female students and 84.7% from male students. As for the age range, 50.2% were students between 18 and 21, 39.6% were students between 21 and 24, and 10.3% were older than 25. According to the current study year and study career, the sample is distributed as shown in Table 2 and Table 3, respectively.

**Table 2.** Distribution of students according to current study year.

| <i>Current study year</i> | <i>Frequency</i> | <i>Percent (%)</i> |
|---------------------------|------------------|--------------------|
| First                     | 110              | 34.3               |
| Second                    | 41               | 12.8               |
| Third                     | 81               | 25.2               |
| Quarter                   | 47               | 14.6               |
| Fifth                     | 42               | 13.1               |
| Total                     | 321              | 100.0              |

**Table 3.** Distribution of students according to study career.

| <i>Study career</i>      | <i>Frequency</i> | <i>Percent (%)</i> |
|--------------------------|------------------|--------------------|
| Industrial Engineering   | 86               | 26.8               |
| Computer Science         | 103              | 32.1               |
| Construction Engineering | 132              | 41.1               |
| Total                    | 321              | 100.0              |

### *Data analysis*

We analyzed the data using SPSS software, focusing on the relationship between students' familiarity with institutional support services and their sense of belonging and self-efficacy. Considering the data's characteristics, non-parametric tests were primarily utilized due to the non-normal distribution of the data. The Mann-Whitney U test was applied to compare

groups of students familiar and unfamiliar with the services, assessing differences in the sense of belonging and self-efficacy. The Spearman Correlation Test was also used to explore correlations between these variables, particularly for students familiar with all services. A threshold of  $p < 0.05$  was set for statistical significance throughout the analysis.

The sample was divided into two groups, familiar and unfamiliar with each service, with descriptive statistics in Table 4. Further analysis involved comparing students familiar with all support services ( $N1 = 140$ ) against those unfamiliar ( $N2 = 181$ ), using the same test to evaluate differences in perceived ease of access and use of these services.

### *Ethical considerations*

We have adhered strictly to ethical principles in our research, which aims to understand the interaction between the university's services and the socio-cognitive aspects of sense of belonging and self-efficacy.

Before data collection, all participants were provided with an informed consent form that clearly described the purpose of their participation. This form ensured that students were fully aware of their rights to abstain from answering the survey without any consequences to their academic standing or university services. We have ensured that participation was completely voluntary, respecting the autonomy of each student.

All student data collected through the validated survey were anonymized and made untraceable to specific individuals, thus preserving student confidentiality. This data was handled and stored with the utmost security to safeguard student privacy. Furthermore, the use of the data was strictly confined to the purposes of this research.

We affirm that this study's findings have no direct or indirect implications for the integrity or personal outcomes of the students involved. Our commitment to ethical research practices is unwavering, and this study has been conducted with a clear focus on generating insights that can enhance educational services and student experiences without compromising individual student welfare.

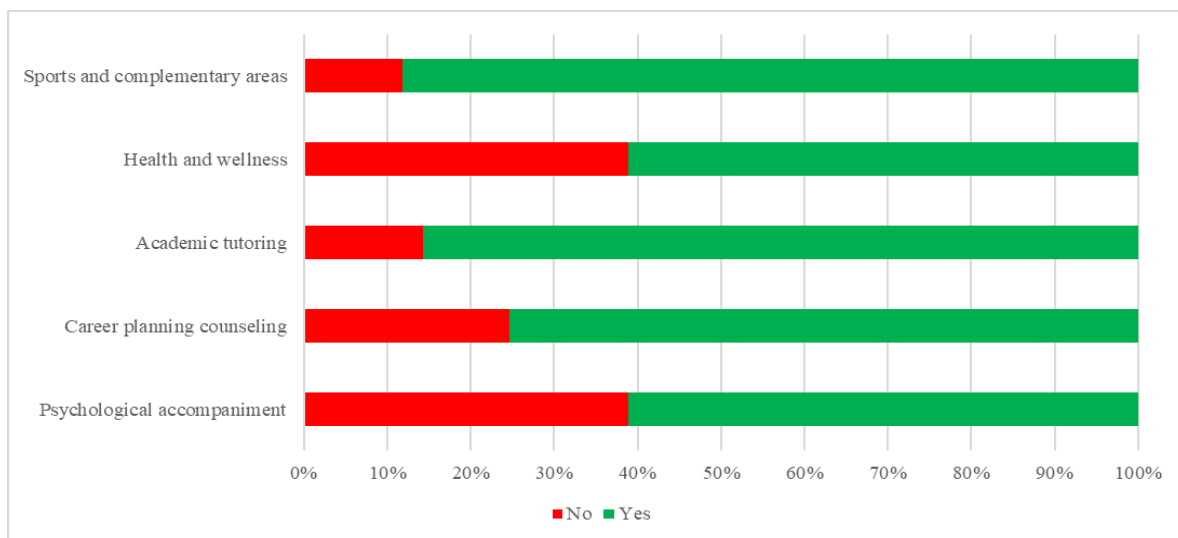
## **Results**

First, a descriptive analysis of the "Perceived Institutional Support" dimension is presented. Subsequently, differences between students who know about support services and students who do not will be studied. Finally, the correlations between perceived institutional support, sense of belonging, and self-efficacy will be introduced.

The percentage distribution, considering students' familiarity with the different institutional support services, is presented in Figure 1. The institutional services with a higher percentage of knowledge resulted in "Sports and complementary areas" (88.16%), "Academic tutoring" (85.67%), and "Career planning counseling" (75.39%). On the other hand, the institutional services with the lowest percentage of students' knowledge were "Psychological accompaniment" (61.06%) and "Health and wellness" (61.06%).

*Evaluating student familiarity with each institutional support service and its relation to sense of belonging and self-efficacy*

To conduct an initial data analysis, it is important to examine each institutional support service and its relationship with the student's sense of belonging and self-efficacy. This requires a separate evaluation of each service, dividing the sample into two groups: students familiar with the service and those not. Table 4 presents the relevant descriptive data. For each institutional support service, the Mann-Whitney U test was employed to determine whether there were significant differences between the groups for the sense of belonging (general and interactions) and self-efficacy variables. No statistically significant differences were found for any of the institutional support services.



**Figure 1.** Distribution of students' familiarity with institutional support services.

*Assessing differences in perceptions of all institutional support services between familiar and unfamiliar student groups*

To investigate further the potential relationship between the perceived ease of access and use of institutional support services, analyses were considered, considering students familiar with all the institutional support services and those not (Descriptives in Tab. 5). We compared two groups of students: those familiar with ( $N_1 = 140$ ) and those unfamiliar with ( $N_2 = 181$ ) all the support services offered by the institution. A Mann-Whitney test was used to assess differences between the groups. The test revealed significant differences in the perception of psychological accompaniment ( $M_1=3.2$ ,  $M_2=1.06$ ,  $U = 4338.5$ ,  $p < 0.001$ ), Career planning counseling ( $M_1=3.66$ ,  $M_2=2.21$ ,  $U = 8012$ ,  $p < 0.001$ ), and Health and wellness ( $M_1=3.3$ ,  $M_2=1.13$ ,  $U = 4582.5$ ,  $p < 0.001$ ). These findings suggest that, in all cases, students familiar with all the services tend to perceive greater ease in locating and utilizing the mentioned support services. Conversely, no significant differences were observed for the dimensions of sense of belonging-general, sense of belonging-interactions, and self-efficacy.

*Exploring correlations between sense of belonging, self-efficacy, and familiarity with all institutional support services*

To analyze the relationships among the variables of interest, Table 6 displays the results of the Spearman correlation test for the group of students familiar with all institutional support services ( $N_1 = 140$ ). The study found significant correlations between students' sense of belonging-general and familiarity with all institutional support services. Table 6 shows



moderate correlations between Psychological Accompaniment, Academic Tutoring, Health and Wellness, and Sports and Complementary Areas. In contrast, the correlation is low for Career Planning Counseling. Additionally, the study identified significant correlations between the sense of belonging-interactions and students' familiarity with all institutional support services. Table 6 also shows moderate correlations with Psychological Accompaniment, Academic Tutoring, Health and Wellness, and Sports and Complementary Areas, while the correlation is low for Career Planning Counseling. The positive correlations indicate that increased students' familiarity with the support services leads to a growth in their sense of belonging.

**Table 4.** Descriptive statistics based on familiarity with institutional support services and survey dimensions.

|                                       | <i>Familiar with the institutional service</i> |     |     |       |           | <i>Not familiar with the institutional service</i> |     |     |       |
|---------------------------------------|------------------------------------------------|-----|-----|-------|-----------|----------------------------------------------------|-----|-----|-------|
|                                       | N                                              | Min | Max | Mean  | Std. Dev. | N                                                  | Min | Max | Mean  |
| <i>Psychological accompaniment</i>    | 196                                            | 1   | 5   | 3.27  | 1.186     | 125                                                | 0   | 0   | 0     |
| <i>Seff</i>                           | 196                                            | 2   | 5   | 4.062 | 0.5656    | 125                                                | 2.5 | 5   | 4.097 |
| <i>SB-g</i>                           | 196                                            | 1.8 | 5   | 3.887 | 0.6263    | 125                                                | 1.3 | 5   | 3.899 |
| <i>SB-i</i>                           | 196                                            | 2.3 | 5   | 3.87  | 0.5824    | 125                                                | 2   | 5   | 3.83  |
| <i>Career planning counseling</i>     | 242                                            | 1   | 5   | 3.77  | 1.011     | 79                                                 | 0   | 0   | 0     |
| <i>Seff</i>                           | 242                                            | 2   | 5   | 4.075 | 0.5354    | 79                                                 | 2.5 | 5   | 4.076 |
| <i>SB-g</i>                           | 242                                            | 1.8 | 5   | 3.911 | 0.6059    | 79                                                 | 1.3 | 5   | 3.832 |
| <i>SB-i</i>                           | 242                                            | 2.3 | 5   | 3.871 | 0.5289    | 79                                                 | 2   | 5   | 3.802 |
| <i>Academic tutoring</i>              | 275                                            | 1   | 5   | 3.79  | 0.935     | 46                                                 | 0   | 0   | 0     |
| <i>Seff</i>                           | 275                                            | 2.5 | 5   | 4.069 | 0.5296    | 46                                                 | 2   | 5   | 4.114 |
| <i>SB-g</i>                           | 275                                            | 1.8 | 5   | 3.89  | 0.601     | 46                                                 | 1.3 | 5   | 3.902 |
| <i>SB-i</i>                           | 275                                            | 2   | 5   | 3.865 | 0.5306    | 46                                                 | 2   | 5   | 3.791 |
| <i>Health and wellness</i>            | 196                                            | 1   | 5   | 3.4   | 1.055     | 125                                                | 0   | 0   | 0     |
| <i>Seff</i>                           | 196                                            | 2.5 | 5   | 4.062 | 0.545     | 125                                                | 2   | 5   | 4.097 |
| <i>SB-g</i>                           | 196                                            | 1.3 | 5   | 3.901 | 0.6326    | 125                                                | 2.3 | 5   | 3.878 |
| <i>SB-i</i>                           | 196                                            | 2   | 5   | 3.851 | 0.5616    | 125                                                | 2   | 5   | 3.859 |
| <i>Sports and complementary areas</i> | 283                                            | 1   | 5   | 3.88  | 0.98      | 38                                                 | 0   | 0   | 0     |
| <i>Seff</i>                           | 283                                            | 2   | 5   | 4.064 | 0.5436    | 38                                                 | 2.5 | 5   | 4.158 |
| <i>SB-g</i>                           | 283                                            | 1.3 | 5   | 3.9   | 0.6195    | 38                                                 | 2.3 | 5   | 3.829 |
| <i>SB-i</i>                           | 283                                            | 2   | 5   | 3.862 | 0.5433    | 38                                                 | 2   | 5   | 3.799 |

\*Seff (Self-efficacy), SB-g- (Sense of belonging general), and SB-i (Sense of belonging interactions).

Concerning self-efficacy, statistically significant positive correlations were found with Career planning counseling, Academic tutoring, Health and wellness, and Sports and complementary areas. As can be observed in Table 6, these correlations are low. No statistically significant correlation was found with psychological accompaniment. These positive correlations indicate that students' self-efficacy increases as familiarity with services, Career planning counseling, Academic tutoring, Health and wellness, and Sports and complementary areas increases.

**Table 5.** Descriptive statistics for students familiar with all institutional support services.

| <i>Dimension</i>               | <i>Familiar with all institutional services</i> |            |             |                  | <i>Not familiar with all institutional services</i> |            |             |                  |
|--------------------------------|-------------------------------------------------|------------|-------------|------------------|-----------------------------------------------------|------------|-------------|------------------|
|                                | <i>Min</i>                                      | <i>Max</i> | <i>Mean</i> | <i>Std. Dev.</i> | <i>Min</i>                                          | <i>Max</i> | <i>Mean</i> | <i>Std. Dev.</i> |
| Psychological accompaniment    | 1                                               | 5          | 3.2         | 1.195            | 0                                                   | 5          | 1.06        | 1.713            |
| Career planning counseling     | 1                                               | 5          | 3.66        | 1.07             | 0                                                   | 5          | 2.21        | 2.066            |
| Academic tutoring              | 1                                               | 5          | 3.51        | 1.049            | 0                                                   | 5          | 3.04        | 1.878            |
| Health and wellness            | 1                                               | 5          | 3.3         | 1.097            | 0                                                   | 5          | 1,13        | 1.761            |
| Sports and complementary areas | 1                                               | 5          | 3.75        | 1.06             | 0                                                   | 5          | 3.16        | 1.811            |
| Seff                           | 2.8                                             | 5          | 4.06        | 0.5413           | 2                                                   | 5          | 4.088       | 0.5595           |
| SB-g                           | 1.8                                             | 5          | 3.88        | 0.647            | 1.3                                                 | 5          | 3.901       | 0.6066           |
| SB-i                           | 2.3                                             | 5          | 3.87        | 0.5657           | 2                                                   | 5          | 3.845       | 0.5561           |

\*Seff (Self-efficacy), SB-g- (Sense of belonging general), and SB-i (Sense of belonging interactions).

**Table 6.** Spearman correlation coefficients.

|                                       |                | Seff   | SB-g   | SB-i   |
|---------------------------------------|----------------|--------|--------|--------|
| <i>Psychological accompaniment</i>    | CC             | 0.158  | .406** | .411** |
|                                       | Sig. (2-sided) | 0.062  | <.001  | <.001  |
|                                       | N              | 140    | 140    | 140    |
| <i>Career planning counseling</i>     | CC             | .182*  | .342** | .288** |
|                                       | Sig. (2-sided) | 0.031  | <.001  | <.001  |
|                                       | N              | 140    | 140    | 140    |
| <i>Academic tutoring</i>              | CC             | .173*  | .279** | .308** |
|                                       | Sig. (2-sided) | 0.041  | <.001  | <.001  |
|                                       | N              | 140    | 140    | 140    |
| <i>Health and wellness</i>            | CC             | .196*  | .430** | .353** |
|                                       | Sig. (2-sided) | 0.02   | <.001  | <.001  |
|                                       | N              | 140    | 140    | 140    |
| <i>Sports and complementary areas</i> | CC             | .288** | .414** | .341** |
|                                       | Sig. (2-sided) | <.001  | <.001  | <.001  |
|                                       | N              | 140    | 140    | 140    |

\*\*The correlation is significant at the 0.01 level (two-sided).

## *Investigating correlations in students unfamiliar with all the institutional support services and their sense of belonging and self-efficacy*

For students who are not familiar with all institutional support services ( $N_2 = 181$ ), statistically significant but low correlations were found only between Sports and complementary areas increases and self-efficacy ( $\rho = 0.173$ ,  $p = 0.02$ ), Sports and complementary areas increases and sense of belonging- general ( $\rho = 0.229$ ,  $p = 0.002$ ), and Sports and complementary areas and sense of belonging-interaction ( $\rho = 0.251$ ,  $p < 0.001$ ).

### **Discussion**

This study explores the connection between students' sense of belonging, self-efficacy, and perceived institutional support in a private university in Chile. Educational institutions play a key role in shaping these elements, which are crucial for student success, especially in STEM fields. Our investigation, set in a school of engineering with a significant proportion of first-generation students (FGS), examines how university-provided services relate to these socio-cognitive aspects. This research aims to deepen our understanding of the unique challenges and dynamics experienced by students, highlighting the importance of targeted institutional support in fostering academic and personal growth.

Our findings elucidate the relationship between student support services and their impact on students' sense of belonging and self-efficacy. Like Li and Singh [8], we found that interactions bolster the students' sense of belonging. This aligns closely with student self-efficacy; a strong sense of belonging positively influences students' self-perceived ability to perform academically in the university setting. Social interactions fostered through various services, such as Career planning counseling, Academic tutoring, Health and wellness, and Sports and complementary areas, enhance sense of belonging and self-efficacy and reduce the risk of students dropping out of their courses [29].

Contrary to expectations, our study unveiled that while the correlations between psychological support and self-efficacy were positive, they were low. This finding is noteworthy, considering that this particular service was relatively unknown among the participants in our survey. Tindle et al. [17] advocate for providing students with specialized psychological and social support to foster their academic and social integration within peer groups. A similar pattern emerged in the context of Career Planning Counseling and its relationship with the sense of belonging. However, a notable correlation with self-efficacy was not observed. Falco [30] emphasizes the critical importance of Career Planning Counseling, especially in guiding students through career choices and financial planning. This aspect holds particular significance in a university setting where 60% of the student body comprises first-generation students, many of whom may need more familiarity with such processes.

In line with expectations, the correlations between sense of belonging and self-efficacy among students unfamiliar with institutional support services were markedly low. This finding substantiates our theory that institutional support positively affects students' sense of belonging and self-efficacy.

## *Implications for Management in Engineering Education*

Regarding management implications for engineering education, we suggest enhancing self-efficacy and a sense of belonging. Managers should ensure that institutions provide psychological support, academic tutoring, career planning advice, health and wellness services, and sports and complementary activities. Based on our findings and the consulted literature, these services positively correlate with students' sense of belonging and self-efficacy. Furthermore, it is advised to personalize support for first-generation students by implementing strategies that recognize and address their specific needs and those of economically disadvantaged students.

## **Conclusion**

This research was conducted to explore the relationship between institutional support and its influence on the sense of belonging and self-efficacy among students in a school of engineering. Utilizing a validated survey completed by 321 students, we collected data crucial for conducting comprehensive impact assessments and correlation analyses. We have reached the following conclusions after a detailed examination and comparison with the existing body of literature.

- The study underscores the relationship between institutional support services and their influence on students' sense of belonging and self-efficacy. Services like Career Planning Counseling, Academic Tutoring, Health and Wellness, and Sports and Complementary Areas enhance these aspects, contributing to a lower dropout rate among students.
- Despite the initial assumptions, the relationship between psychological support and self-efficacy was positive but weak. This discovery holds significance, particularly as many students surveyed were unfamiliar with these services. This highlights the necessity for more efficient communication and promotion of these services to increase their effectiveness.
- The study highlights the crucial role of Career Planning Counseling, especially in aiding students with career choices and financial planning. This service is particularly important in a university with a high percentage of first-generation students who might need to become more familiar with these processes.
- There were notably low correlations between sense of belonging and self-efficacy among students unfamiliar with institutional support services. This finding supports the theory that institutional support positively affects these aspects of student life.
- For the management of engineering education, the study suggests prioritizing services that bolster self-efficacy and sense of belonging, such as psychological support, academic tutoring, career planning, health and wellness, and sports activities. It also emphasizes tailoring support to the specific needs of first-generation and economically disadvantaged students.
- Based on our experience as instructors and researchers and our review of relevant literature, promoting peer interaction improves connections among classmates and strengthens their sense of belonging. Considering this, we advocate for the enhanced use of advanced technologies and digital platforms to facilitate access to educational and support resources. We recommend that educational institutions embrace a student-centered pedagogical approach. This approach should include group work, individual and collaborative reflection exercises, peer discussions, and constructive feedback. Such measures enrich learning experiences and cultivate an inclusive, supportive educational environment.

### *Limitations and future work*

Understanding how students perceive support services and the benefits they receive is crucial in a private university where 60% of students are First-Generation Students (FGS). As a result, the study's findings are significant because they provide insights into the relationship between support services and the student's sense of belonging and self-efficacy. However, the study has some limitations. Firstly, it failed to include sociodemographic variables that would identify whether a student belonged to the FGS group or not to explore in greater depth. Secondly, the sample needs to be representative of women, which is a limitation in studying differences between men and women. Although women are underrepresented in engineering programs, a more balanced sample is necessary. Lastly, the study omitted socioeconomic, familial, and other backgrounds in the sociodemographic variables, which could impact the student's sense of belonging and self-efficacy.

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