Factors Influencing Career Choice, Perceived Discrimination, and Segregation of Foreign-Born Engineering Undergraduates*

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The underrepresentation of foreign-born students in engineering degrees is persistent and fosters social disparities in job opportunities and income for future generations. On the one hand, this underrepresentation is related to the fact that foreign-born students choose engineering studies less frequently than native-born students. On the other hand, it is also related to the hostile and discriminatory environment in engineering degrees.

The present research conducted in Spain provides new evidence on differences in students' career choice factors according to their place of birth and the relationship these factors may have with students' academic persistence. In addition, this research explores the exclusion and segregation of foreign-born students and the relationship between segregation and perceived discrimination, providing new data on the specific situations in which segregation and discrimination occur.

The study was carried out based on a cross-sectional survey of 602 engineering students of the Universitat Politècnica de Catalunya-BarcelonaTech. Descriptive and inferential statistical methods were used to analyze the dataset. The results showed significant differences between native-born and foreign-born students among the factors that motivated them to enroll in engineering degrees. Some of the most significant differences were that native-born students felt more motivated than foreign-born students by their skills, aspiring for a high salary, and having a job that made them feel fulfilled. Moreover, a significant association was found between foreign-born students' academic persistence and the factors that motivated them to enroll in engineering, such as family support, getting a satisfying job, and having a high salary. Regarding segregation, native-born students were significantly less likely to interact with students from different origins than foreign-born students. Leisure time and extracurricular activities were the situations in which native-born students interacted the least with students from different origins. Furthermore, in the classrooms where native-born students interacted most with other students, foreign-born students felt most discriminated against. Possible explanations for these findings are discussed in the study.

Keywords: career choice; engineering education; inclusion; segregation; underrepresented minorities

1. Introduction

Although enrollment in higher education has doubled in recent years, there are disparities in terms of gender, origin, and ethnicity [1, 2]. These disparities differ by academic discipline, and in some scientific fields, such as engineering, the student body remains overwhelmingly white, male, and native-born [2, 3].

To address these gaps, the European Union (EU) has agreed to achieve that the percentage of the population aged 25–34 with higher education

exceeds 45% by 2030 [4]. Data from 2021 show that some population groups, such as women, have already reached the established target, with 46.8% of women between 25 and 34 years of age with higher education studies [5]. However, other population groups continue to lag far behind, such as the foreign-born, of whom only 36.2% have higher education studies compared to 42.1% of the native population with higher education studies [5]. These differences between the foreign-born population and the native-born population are greater in some EU countries, such as Greece, Slovakia, and Spain, where the percentage of the foreign-born population between 25 and 34 years of age with higher education barely exceeds 30%, with a difference of more than 20 percentage points from the native-born population [5]. In order to achieve the 2030 target, it is crucial to analyze these countries in which the differences are greatest to identify what actions can be implemented to increase the share of students with higher education degrees.

The current study was carried out in Spain at the Universitat Politècnica de Catalunya Barcelona-Tech (UPC), a public university for research and education in Science, Technology, Engineering, and Mathematics (STEM). The university's enrollment data reflect the disparities discussed above. While in 2021, the country's foreign-born population represented 15.5%, at UPC, only 7.1% of the student body was of foreign nationality [6, 7].

Reducing these inequalities in higher education is a matter of national and international concern and a fundamental element of equality policies as they lead to knowledge disparities with severe consequences for social and economic development [8]. Moreover, it is a key point of the Sustainable Development Goals (SDGs) of the 2030 Agenda set by the United Nations, which establishes the SDG 4 "Quality education" to achieve equitable and inclusive education, promoting learning opportunities for all, and the SDG 10 "Reduced inequalities" to eliminate population disparities [8, 9].

Promoting and diversifying participation in engineering brings benefits at individual and collective levels, helping to evolve towards a more ethical and egalitarian society. First, as engineering professions are among those with the highest pay and job growth [10], increasing the participation of underrepresented groups will contribute to achieving equality in income and career opportunities among the population, aligned with the SDG 8 "Decent work and economic growth". Moreover, it will help improve the representation of the population's diversity in positions of influence and management in the engineering industry, which are currently held primarily by native-born white men [11]. If the field of engineering is to lead technological development, it is imperative that the analysis of problems and the design of solutions is not only done from the perspective of a particular social group that is not representative of the diversity of the population. Furthermore, achieving a greater representation of underrepresented engineering students will also help break the established stereotypes and increase the exposure of role models for future generations [12]. Finally, several studies have shown that heterogeneous work groups exhibit better problem solving than homogeneous groups and that learning in a diverse environment is of great importance for the academic development of the entire student body, as it promotes critical and innovative thinking and fosters problem-solving [13]. In addition, the fact that students learn alongside students from different origins and backgrounds causes them to develop more open and respectful attitudes and greater cultural awareness and empathy [14, 15]. These skills have become particularly relevant in a globalized world with increased cross-cultural communication and development.

Despite the efforts made to promote the participation of underrepresented students in engineering degrees, disparities are persistent, and the actions implemented so far have not been enough. For this reason, it is imperative to continue researching to provide new empirical data that helps explain the factors influencing these inequalities. To this end, the present study analyzes the situation of foreignborn students in engineering studies at two key points of the academic experience: students' career choice and the inequalities in the academic experience once they have enrolled. This information will help the academic community understand how underrepresented students feel and live the experience of choosing and pursuing engineering studies, what significant differences exist compared to the majority group of native-born students, and what factors may be detrimental to their participation along the pipeline.

1.1 Theoretical Framework

The underrepresentation of foreign-born students and students from different origins in engineering degrees has been related to the strong stereotypes present in this field, which traditionally link engineering to the male, native-born, white, middle- and upper-class population, a profile that makes up the majority of students enrolled in engineering degrees [16–18]. Stereotypes are based on preconceived biases, beliefs, and opinions in society and culture that are generalized to individuals who are part of a stereotyped group [19]. Such biases can be unconscious so, the person is unaware of having learned unintentional and deeply engrained stereotypes that can influence their behavior, interactions, and decision-making [20]. For example, a teacher may believe that he or she does not treat students differently depending on their place of birth or ethnicity but still unconsciously expect different results from those students, which may affect how they qualify them. Therefore, although it may be unconscious, stereotypes influence attitudes and behaviors, establishing certain social expectations about the people who are part of the stereotyped group and perpetuating social gaps and underrepresentation [21].

On the one hand, these stereotypes can affect student access to engineering degrees. Previous literature showed that underrepresented groups enroll in engineering less than students belonging to the majority group. One explanation is that the stereotypes present in the STEM field set different expectations based on individuals' social identities, such as gender or national origin, which affects students' self-expectations, interests, and motivations [22-24]. This occurs because stereotypes are an essential decision criteria by which a degree is chosen and students usually choose them based on whether or not the studies are appropriate according to the roles established by stereotypes [25]. Those degrees that do not match the stereotypes will cease to be considered vocationally aspirational, making the likelihood of having an atypical vocational aspiration low, as in the case of foreignborn students in engineering studies [26]. In addition, students from underrepresented groups may have the perception of being less welcome to engineering degrees than students from the majority group as they may perceive a hostile climate due to the stereotypes and unconscious biases in the field, which may also affect their decision to enroll in the studies [27–29]. In order to encourage the participation of foreign-born students in STEM disciplines, it will be essential to understand how interests are shaped and what differences exist between native-born and foreign-born students in order to understand what aspects need to be addressed and reinforced to promote the interest of underrepresented groups in STEM fields and thus break the established stereotypes.

Previous literature has identified some elements that can affect the decision to pursue a career in STEM. First, widely validated theoretical frameworks, such as Expectancy-Value Theory [30] and Social Cognitive Career Theory [31], showed that a person is more likely to develop an interest and choose a career in which he or she feels more competent and expects more satisfactory outcomes. In this manner, students who do not fit established stereotypes in the STEM field tend to feel less confident about their abilities [23, 32, 33], which lowers their outcome expectations and undermines career interests in engineering degrees [21, 22, 24]. Second, receiving support and encouragement from parents, teachers, and friends, can play an essential role in determining students' career decisions [34-36]. Finally, there are extrinsic motivational factors that may also affect the decision. For example, STEM fields are often associated with high-status, stable, and well-paid careers; reasons that are also considered when choosing a career [10, 37, 38].

While there has been much research on career choice factors for women in STEM [22, 32, 35],

previous research on engineering career choice by foreign-born or underrepresented minority students is very sparse. Since these factors may be influenced by personal characteristics and social identities [39], it is necessary to expand the current research by taking into account students' place of birth to study whether choice factors differ between students belonging to the majority group and underrepresented students and examine whether these differences may foster the underrepresentation of foreign-born students in engineering. In addition, some gaps still need to be bridged in students' career choices in engineering degrees. First, several previous studies treated all STEM fields as a whole without analyzing the differences between STEM subdisciplines [40, 41]. Analyzing all STEM fields together makes it difficult to assess the extent to which career choice factors may be shared or different between STEM subdisciplines. In addition, most previous research examining students' interests in STEM studies has focused on prior levels of education, such as elementary and secondary school [42, 43], so less is known about the reasons that motivated underrepresented students who managed to break through stereotypically established barriers and actually end up enrolling in engineering degrees. Finally, it will be worthwhile to understand whether these motivational factors when choosing a degree may have some relationship with students' academic persistence. Since motivation can influence the extent to which an individual strives to achieve a particular goal, such as getting a good grade on an exam or obtaining a degree, some studies indicated that motivations play an important role in task completion and persistence [32, 44, 45]. In fact, intrinsic motivations, those based on doing an activity for inherent satisfactions such as vocation rather than for some external incentives, pressures, or rewards, are considered optimal prerequisites to endure and strengthen the involvement in a domain. Otherwise, involvement based on external motivation, such as getting a high salary, is much more likely to break down in the event of adverse situations such as disappointment, failure, or stereotyping [32, 45-47]. Providing new empirical evidence to address these gaps will be of great value as it will help to explain what factors can be promoted to attract these students who are not currently enrolling in engineering degrees and what factors may strengthen their persistence during their studies.

On the other hand, the stereotypes in STEM fields can also affect the academic experience and persistence of those students who belong to stereotyped groups and still decide to enroll in engineering studies. When stereotypes are used to judge an individual negatively, even if unconsciously, they can lead to different treatment and trigger situations of discrimination and prejudice. In several studies, students from underrepresented groups reported experiencing higher levels of alienation and prejudice than their counterparts on engineering campuses, perceiving the environment as threatening and hostile [27-29]. These experiences of discrimination and prejudice in educational settings can decrease underrepresented students' academic persistence and lower graduation rates [48-54]. To better understand how to improve the persistence of foreign-born students, it is critical to identify the factors that promote their dropout during studies. As demonstrated by previous investigations, a relevant construct for assessing the likelihood that a student will persist during their studies is his or her intention to drop out [28, 49-51, 55, 56]. The results of these investigations proved that foreign-born students' dropout intentions are significantly related to academic discrimination, with those who perceive greater discrimination having greater intentions to drop out. Therefore, it will be essential to study the dropout intentions of foreign-born students enrolled in engineering studies to understand whether their academic experience and the perceived discrimination can affect their persistence. Identifying students' dropout intentions before they drop out is crucial to foster retention actions to prevent students' academic abandonment.

In addition, the fact that foreign-born students may perceive the engineering campus as a hostile environment may lead to the segregation and isolation of these students [57, 58]. Underrepresented students may self-segregate into safer intragroup contexts to reduce the negative experience of deprivation [59], self-isolating into homogeneous safer groups to protect themselves from the discriminatory environment [60]. Otherwise, the majority student group may also be the ones excluding underrepresented students or students belonging to a stereotypical group. Although this segregation can help foreign-born students reduce their perception of discrimination as they only interact with peers from the same background or other underrepresented minorities, it may pose a barrier to integration on the college campus and can have significant drawbacks. As Levin et al. [61] noted, students with more out-group friends in college are more likely to have positive attitudes toward people from different social groups and identities at the end of college. Conversely, when people share similar views and attitudes and isolate themselves from other groups with different backgrounds and ideas, this isolation strengthens the belief that the group's views are the correct and considered normative ones, leading to greater ethnocentrism and racial intolerance and fostering negative attitudes towards people who belong to other social groups and origins. In the long run, this will lead to an engineering workforce with professionals who are less respectful of people of different backgrounds, ethnicities, and social identities. Furthermore, it makes it impossible for students to benefit from the advantages provided by a diverse academic environment, such as critical and innovative thinking and the opportunity to solve problems from different perspectives and points of view [14], vital skills in the STEM field.

Eliminating segregation and achieving student inclusiveness by promoting diverse interactions on campus can bring multiple benefits to the student body. For example, in the study by Hall et al. [49], it was found that having a diverse group of friends in STEM studies was positively associated with students' academic self-efficacy and their intentions to major in STEM. Besides, Hussain and Jones [62] found that more diverse peer interactions buffer the negative effects of discrimination. Unfortunately, there is a scarce investigation that analyzes in which situations on the engineering campus segregation or exclusion of minority students occur and if there is a relationship with the perceived discrimination in these situations. Furthermore, most of the research on segregation and discrimination on engineering campuses has been conducted in the United States [27, 29, 48–50, 52, 53, 61, 62], where the variability of the population and the culture is different from those in other regions of the world, so the results obtained in these studies may not be generalizable to other countries. For this reason, it is necessary to extend the research to other world regions to determine whether the findings obtained so far are reproduced in other social contexts with different populations, as in the case of this research.

1.2 The Present Study

Against this background, the present study analyzes the differences between native-born (NB) and foreign-born (FB) students in a sample of students enrolled in engineering degrees on the factors that motivated the choice of enrolling in an engineering degree and the relationships between these factors and students' dropout intentions. Moreover, the study explores the interactions among students to explain whether segregation exists and its possible impact on perceived discrimination.

With this aim, the research addresses the following research questions:

1. Do NB and FB students enrolled in engineering degrees differ in the factors that motivated them to choose engineering degrees? So far,

most studies provide information on why students are interested in choosing a career before enrolling in university studies. This work analyzes the career choice factors of NB and FB students enrolled in engineering degrees.

- 2. Are the factors by which students felt motivated to choose an engineering degree associated with their persistence during their studies? There may be an association between these factors and students' dropout intentions, as motivational factors and interests influence the persistence in pursuing a goal, such as graduating with an engineering degree.
- 3. Do NB and FB students enrolled in engineering degrees interact with each other? This study analyzes the extent to which NB and FB students interact with students from different origins and ethnicities to explore if there is segregation on the engineering campus. In addition, the research expands the current literature by identifying in which specific spaces or situations they interact more with other student groups. This information will help to explain in which spaces on the academic campus there is segregation or exclusion.
- 4. Is there a relationship between students' interactions with students from different origins and ethnicities and their perception of discrimination? This study analyzes whether there is a correlation between both variables and deepens existing knowledge by analyzing whether there is any relationship between the situations where students interact more with each other and those in which foreign-born students feel more discriminated against and vice versa.

2. Methodology

2.1 Participants

The current study was conducted at the UPC in Catalonia, Spain. The UPC is a public university for research and education specialized in STEM degrees. It was based on a cross-sectional survey of a non-probabilistic voluntary sample of students enrolled in engineering degrees. With a response rate of 54%, a total of 602 students answered the questionnaire, with a confidence level of 95% and a margin of error of 5%. Participants were selfselected, and no incentive was given to them to participate in the study. The anonymity of the participants and the confidentiality of the data collected were guaranteed. Duly consideration was given to the protection of personal data, ensuring that all recipients had agreed to receive communications. Table 1 summarizes the demographic characteristics of the students participating in the study.

Baseline characteristic	n	%			
Gender					
Male	450	74.8			
Female	152	25.2			
Place of birth					
Native-born	368	61.1			
Foreign-born	234	38.9			

Table 1. Demographic Characteristics of the Participants

Note. N = 602.

2.2 Measures

For this study, a questionnaire was designed with measures derived from previous literature and adapted to fit the research context. The full questionnaire can be found at the following link: https://forms.gle/kE7jPBsQnqFQpQ2q8

First, sociodemographic data were asked to characterize the sample, such as gender or students' place of birth. To assess the factors that motivated the choice of STEM as a career, the Factors Influencing Teaching Choice (FIT-Choice) scale [63], a widely known and validated measure for assessing educational career choice factors, was adapted to the engineering field. The measure comprised a multiple-choice question with eleven motivational factors for career choice (e.g., "It is my vocation"). To analyze whether students interacted with other students, a measure was designed specifically for this study. First, participants were asked whether they interacted with students from other origins and ethnicities at the university on a 4point scale (1 = Never to 4 = Very often). Next, they were asked in which situations they interacted with these students on the university campus with a multiple-choice question (e.g., "In group work activities"). Students' intentions to drop out were measured using a single item based on Bunker et al. [64], and participants were asked to indicate whether they had thought about changing or quitting their engineering studies on a 4-point scale (1 =Never to 4 = Very often). Finally, perceived discrimination was assessed with a set of five items adapted from Pachter et al. [65]. Five experiences of discrimination (e.g., I have not been treated with the respect I deserved) were presented, and students were asked to indicate whether any of the situations had happened to them on a 4-point scale (1 = Never to 4 = Very often). Cronbach's alpha of the scale showed adequate reliability ($\alpha = 0.72$). In addition, a question designed for this study was added about the situations in which these discriminations occurred (e.g., "In group work activities").

2.3 Procedure

The recruitment of participants was carried out during the second semester of the 2019–2020 aca-

demic year. The questionnaire developed with Google Forms[®] was emailed by the authors of this research and teachers along with a motivation letter explaining the purpose of the study. Participants were encouraged to answer all questions honestly and in accordance with their opinions. Before administration, the questionnaire underwent a validation process to identify whether the questions were clear and well-formulated and to detect possible errors in its design.

For the analysis, the sample collected was characterized, and the variables were defined and classified. Table 2 shows the labels designated for the variables corresponding to career choice factors, the situations in which students interacted with students from other origins and ethnicities, and the situations where they felt discriminated against. Students' place of birth was transformed into a dichotomous variable. Students born in Spain, the country in which this study was conducted, were categorized as NB students. Students born in other countries were categorized as FB students. Preliminary analyses were performed to assess missing values and outliers and to characterize the sample. The chi-square test of independence was used to analyze the relationship between career choice factors with students' place of birth and dropout intentions. The chi-square test of independence was also used to explore the relationship between students' place of birth and the situations in which they interacted with students from different origins and ethnicities. Spearman's correlation was used to assess the correlations between students' interactions, perceived discrimination, and dropout intentions. In the analyses, p < 0.05 was considered statistically significant.

3. Results

The initial data set of 602 participants was evaluated for missing data and outliers. After removing 4 extreme outliers, the final data set consisted of 598 participants. No missing values were found due to the mandatory completion of the questions. No participants were excluded as all respondents met the criteria for participation in the study.

Fig. 1 shows the factors that motivated NB and FB students to enroll in engineering studies. As can be seen, the most frequent reasons for both groups were, firstly, having a job that makes them feel fulfilled and, secondly, their skills in the area. In addition, for both groups, the ease of finding a job, their vocation, obtaining a high salary, and having the support of the family were relevant factors. For FB students, the impact on society was also noteworthy. Regarding the differences between both groups, the results showed significant differences between NB and FB students in the factors that motivated them to choose engineering studies. NB students were more likely to choose engineering because of their skills in the area (X2 (1, N = 598)) = 11.25, p = 0.001), being able to get a high salary (X2 (1, N = 598) = 3.86, p = 0.049), and having a job that makes them feel fulfilled (X2 (1, N = 598) = 7.16, p = 0.007). In contrast, FB students were more likely to choose engineering to have a positive impact on society (X2 (1, N = 598) = 4.43, p =0.035).

As can be seen in Table 3, this study provides the associations between career choice factors and students' intentions to drop out. As the results showed, FB students who were more motivated to enroll in engineering because of their family, the

Measure	Survey item	Variable	
Career choice fa	actors My family	Family	
	My friends	Friends	
	My teachers	Teachers	
	It is my vocation	Vocation	
	My skills in the area	Skills	
	To get a high salary	Salary	
	Ease of finding a job	Find_job	
	Having a positive impact on society	Impact_society	
	To have a job that makes me feel fulfilled	Feel_fulfilled	
	Having a job that makes it easy for me to raise a family	Start_family	
	The possibility of working as part of a team	Teamwork	
Interaction and perceived discrimination situations	During lectures such as theoretical or practical classes	Classes	
	In group work activities	Group_work	
	During leisure time in spaces such as the bar, cafeteria or dining room	Leisure_time	
	Outside class hours or in extracurricular activities	Extracurricular_activities	

Table 2. Variables Related to Career Choice Factors and Interaction and Perceived Discrimination Situations

Note. N = 598. Native-born n = 364. Foreign-born n = 234.

	Native-born dropout intentions ^a		Foreign-born dropout intentions ^b	
Variable	X ² (1)	р	<i>X</i> ² (3)	р
Family	0.23	0.972	13.60	0.004
Friends	1.10	0.778	5.97	0.113
Teachers	0.61	0.895	4.77	0.189
Vocation	30.97	0.000	0.90	0.826
Skills	5.74	0.125	1.48	0.687
Salary	8.82	0.032	9.69	0.021
Find_job	5.20	0.158	16.27	0.001
Impact_society	4.65	0.200	3.05	0.384
Feel_fulfilled	8.50	0.037	13.76	0.003
Start_family	2.86	0.413	9.43	0.024
Teamwork	3.63	0.304	7.14	0.068

Table 3. Frequencies and Chi-Square Results for Career Choice Factors by Students' Dropout Intentions

Note. N = 598; ^an = 364; ^bn = 234.

possibility of having a high salary, the ease of finding a job, and the possibility of getting a job that made them feel fulfilled and that would allow them to raise a family, were the ones who had fewer intentions to drop out. In the case of NB students, vocation was also related to their intentions to leave their studies, so the more vocation, the fewer intentions to leave their degree. These findings may help to identify the impact that motivational factors in the choice of studies can have on student retention and identify which ones should be promoted to improve student persistence.

Regarding students' interactions, it was found that NB students interacted significantly less often with students from different origins and ethnicities than FB students (X2(1, N = 598) = 39.33, p =0.000). When analyzing which in specific situations these interactions happened, FB students pointed out with a significantly higher proportion having interacted with students from other origins in group work activities, during leisure time in common areas, and outside class hours and extracurricular activities (Table 4). Classes were the only context in which, although a higher percentage of FB students reported having interacted with students from different origins and ethnicities, the difference with NB students was not significant.

Furthermore, regarding the situations in which students felt more discriminated against, it can be observed that in classes, where NB students interacted more with students from different origins and ethnicities, FB students felt more discriminated against. On the contrary, in group activities, leisure time, and extracurricular activities, situations in which NB students interacted less with students from other origins, FB students felt less discriminated against. Furthermore, when studying the correlations between the variables, it was found that having relationships with students from origins other than one's own was positively correlated with the perception of discrimination (r = 0.136, n = 598, p = 0.000), so those FB students who had more interaction with other students from different origins felt more discriminated against. It is worth noting that, in addition, discrimination perceived was significantly correlated with students' inten-

	Native-born ^a		Foreign-born ^b					
Variable	n	%	n	%	$X^{2}(1)$	р		
Interaction situations								
Classes	300	82.4	202	86.3	1.34	0.248		
Group_work	230	63.2	174	74.4	7.61	0.006		
Leisure_time	76	20.9	68	29.1	4.78	0.029		
Extracurricular_activities	88	24.2	76	32.5	4.53	0.033		
Perceived discrimination situations								
Classes	28	7.7	32	13.7	5.01	0.025		
Group_work	20	5.5	20	8.5	1.67	0.197		
Leisure_time	26	7.1	16	6.8	0.00	1.000		
Extracurricular_activities	10	2.7	2	0.9	1.72	0.190		

Table 4. Frequencies and Chi-Square Results for Interaction and Perceived Discrimination Situations by Students' Place of Birth

Note. N = 598; ^an = 364; ^bn = 234.



Note, N = 598; Native-born n = 364; Foreign-born n = 234.

Fig. 1. Career Choice Factors by Students' Place of Birth.

tions to drop out (r = 0.247, n = 598, p = 0.000). These results may help to understand how the student body interacts with each other within the academic campus and in which situations segregation and discrimination are more likely to occur. This information will be useful in establishing strategies to eliminate discrimination on engineering campuses and promote student integration.

4. Discussion

As can be seen in the results obtained from this study, significant differences have been found between both groups of students from which interesting reflections can be made, and hypotheses can be put forward for analysis in subsequent research.

Regarding career choice factors, FB students indicated their skills in the area to a lesser extent as a relevant factor in career choice than NB students. As some studies in the field pointed out, this finding may be related to the stereotype threat in engineering degrees, which makes those who do not fit these stereotypes feel less capable and have less confidence in their abilities [66, 67]. A relevant finding is that FB students indicated to a lesser extent the expectations of having a good salary and having a profession that makes them feel fulfilled as reasons for enrolling in an engineering degree, even though engineering is a profession with high salaries and status [10, 37, 38]. One possible explanation may be the wage and opportunity gap between native-born and foreign-born professionals [68, 69], which results in FB students not having the same salary and position aspirations as NB students despite enrolling in the same engineering degree program. In addition, FB students indicated to a greater extent having a positive impact on society as a relevant factor in their career choice. This finding aligns with previous studies on motivators in decision-making processes, which indicate that white male students tend to have more individualistic values and to be more interested in personal goals such as having a high salary or obtaining a certain professional status [30, 70-72] than other students, such as women, foreign-born students, or certain minority ethnic students, whose values tend to be more collectivist [73, 74]. Based on these results, to attract more diverse talent to the engineering field, it would be relevant to give more visibility to the social impact that engineering can have on society and encourage a more collective vision of these studies, beyond promoting personal interests such as high salary or career projection [75]. In addition, it is necessary to achieve equality in the engineering industry in terms of salary and decision-making positions among people from different origins and backgrounds to promote that young people from underrepresented groups can have the same professional aspirations in this field as their peers from the majority group.

In line with other studies [12, 76, 77], the support students received from their families was a relevant factor and may even reduce the likelihood of dropping out of their studies. For this reason, efforts to break the stereotypes must also be made within the personal and family environment of the students in order to receive support from their environment to enroll in careers even if they do not fit with the established stereotype. Other motivational factors associated with FB students' dropout intentions were those related to job prospects, such as the ease of finding a job and that the job makes them feel fulfilled and has a high salary. Often, these are values for which the universities promote engineering careers, so it is consistent that they emerged as motivators for students. However, it is curious that in the case of NB students, the fact of being able to easily find a job did not show an association with their persistence while, in the case of FB students, the easiness of finding a job as well as having a job that allows them to raise a family was associated with their dropout intentions. One possible explanation may be that, given that it is often more complicated to find a job for those foreign-born due to the stereotypes and prejudice that exist in society [78, 79], it may be a more relevant factor for FB students when pursuing a degree. An unexpected result is that vocation was only related to intentions to drop out in the case of NB students. Considering that the FB students who enroll in engineering studies are overcoming many barriers, one would expect that they would have a

high vocation and that this would be a relevant driver for their academic progress. It would be interesting for further research to look more deeply into the construct of vocation among engineering students according to their origin or place of birth in order to explain this finding.

Furthermore, this study analyzed students' interactions with students from different origins and ethnicities. Aligned with previous studies on segregation and alienation on university campuses [58], the results showed that, in general, NB students were less likely to interact with students from other origins and ethnicities than FB students. This finding suggests that segregation exists on engineering campuses and that students of the majority group exclude or fail to interact with students from other backgrounds, making it difficult for students to integrate and take advantage of the benefits that diverse peer interactions can bring, such as fostering creative thinking and problem solving [13] and the development of more empathetic and respectful behaviors among the student body [14, 15]. The results of the present study extend previous knowledge by identifying the environments in which these segregations occur the most. According to the results, segregation exists especially in group work activities, in leisure time in spaces such as the bar, cafeteria, or dining hall, and in extracurricular activities, settings in which NB students were significantly less likely to interact with students from different origins and ethnicities. In contrast, in classes, no significant differences were found between the two groups, so both NB students and FB students interacted within classes with students from other origins. One explanation for these findings is that while in the classroom, students are required to interact with students from different backgrounds, in environments where they are not obliged to interact, such as group work activities in which partners can be chosen or in common areas and outside of class hours where they can decide whom to go with, these interactions do not occur to the same extent, leading to greater segregation. These results indicate that the efforts that may be being made within the classes for students to interact with each other are not transferring to other areas and spaces on the academic campus. Therefore, the institution should reinforce student integration actions beyond the classroom, for example, by organizing extracurricular activities for the entire student body with faculty supervision to foster positive relationships among students, such as activities like visits to museums, cultural trips, sports activities or workshops and courses of interest to students outside school hours. In addition, the institution may host discussion forums on discriminatory behaviors or organize outreach

talks and discussions with people belonging to vulnerable groups to give a personal and up-close view of prejudice, discrimination, and unconscious bias, as well as the importance of inclusion in the academic environment [80]. It will also be relevant to offer training and practical workshops on the detection of bias and prejudice and the tools for confrontation and intervention, both for students who suffer discrimination and for witnesses, in order to generate a network of allies in the academic community [81].

This study has found worrying results concerning the association between students' interactions and their perception of discrimination. First, perceived discrimination was related to the interactions with students from different origins and ethnicities, such that the greater the interaction with students from other origins, the greater the perceived discrimination. As the results show, in classes, which is where NB students indicated that they interacted more with students from different origins, is where FB students reported feeling more discriminated against. This finding suggests that it is not enough to bring students of different backgrounds, nationalities or ethnicities into the same space and wait for inclusion to emerge; instead, teachers must take an active role and ensure that no one feels discriminated against in interactions among students during class. Although these discriminations may be due to subtle or unconscious actions [82], they can have a relevant impact on the prejudice and discrimination that FB students feel during their interactions with other students on the engineering campus. On the other hand, in spaces where NB students do not interact as much with other students from different origins and ethnicities, FB students did not feel significantly more discriminated against than NB students, and their perception of discrimination was also lower than in classes. One possible explanation is that as underrepresented students can choose whom to interact with in extracurricular activities and leisure time, it can make these environments safer for them. In contrast, in the classroom, where students cannot choose their peers, FB students felt more threatened. These results may indicate that segregation is acting as a coping strategy for FB students. Coping strategies refer to the cognitive, behavioral, and emotional efforts used to manage stressful or unpleasant situations [83]. These strategies can cause students to have a lower perception of discrimination than they actually have to face. As previous studies indicated, in the case of underrepresented students or foreignborn students, isolating themselves in safer intragroup contexts, such as ethnically homogenous groups, can help them to reduce their negative experiences and protect themselves from the dis-

criminatory environment [59, 60]. However, this tendency toward grouping or distancing may pose a barrier to campus integration and lead to increased ethnocentrism and racial intolerance, fostering negative attitudes among students. Therefore, academic personnel must ensure that interactions between students from different origins and backgrounds are enriching and that the bonds established expand beyond the classroom. For example, some dynamics can encourage students to interact with other classmates beyond their group of friends in group work activities, such as the previous creation of groups or the establishment of rules, such as the rotation of students in the team in each practice. Strengthening relationships within the classroom, with teacher supervision to ensure good working dynamics, can help reduce segregation outside the classroom. Moreover, events outside school hours and extracurricular activities can also be organized during the academic year to encourage student encounters beyond the classroom. Finally, in line with previous studies [48-53], the perception of discrimination was correlated with FB students' dropout intentions, so if the required attention is not given to reduce prejudice and eliminate discriminatory treatment of foreignborn and minority students, their dropout may increase and thus aggravate the underrepresentation of these groups.

4.1 Limitations and Future Work

Although this study provides valuable information about the academic experience of FB students in engineering degrees, the results should be interpreted in the context of some limitations that can be addressed in future research.

First, the sample was segmented considering students' place of birth. This categorization is aligned with the goal set by the EU to achieve that 45% of the population between 25 and 34 years of age have higher education by 2030 [4]. Since the foreign-born population is the group that is farthest from achieving this target and is also underrepresented in engineering studies, it was considered that segmentation between native-born and foreign-born students was of value to obtain relevant results. Although the results obtained in this study provide novel findings for the literature and significant differences that invite reflection for future research, subsequent investigations could conduct a more comprehensive study by examining separately the different nationalities or students' places of birth.

Furthermore, it should be noted that the analysis did not take into account how long students had been living in the country. Future investigations could consider including this variable since the length of time students have been in the country may affect their language proficiency or integration into the country and its culture and, therefore, their academic experience. In addition, the group of NB students may contain students who, although native-born, can belong to underrepresented ethnic or racial groups. For this reason, it would also be interesting to consider students' ethnicity, racial group, or physical characteristics, such as skin color. Previous studies indicate that when minorities of different ethnicities are analyzed individually, relevant differences between groups can be observed [84-86]. However, it should be kept in mind that this is sensitive information and may discourage students from participating in the study or create a bias in responses [87].

Regarding the results on the relationship between students' interactions and FB students' perception of discrimination, future studies could delve into what kind of interactions are perceived as discriminatory and analyze whether they originate consciously or may originate unconsciously due to implicit bias. For example, the implicit association test (IAT) might be used to measure implicit stereotypes held by students [88–90].

It also should be kept in mind that the study was conducted using a questionnaire, so the measurements were based on students' self-reported perceptions. Finally, the results of this study can be extended by validating some of the hypotheses raised in the discussion section, for example, by analyzing them in more detail using mixed methods and including qualitative research techniques.

5. Conclusions

This study shows current disparities in engineering degrees according to students' place of birth. First, differences have been found in the factors that motivate students to choose engineering studies. This information can help engineering institutions to know which factors underrepresented students value the most when choosing their studies and thus be able to take them into account in recruitment strategies to improve their participation in engineering degrees. In addition, the results show differences that may be subject to the stereotypes in STEM, such as foreign-born students being less motivated by their skills in the field. In addition, the association of career choice factors with career dropout intentions is investigated, information that may help to understand what elements may encourage foreign-born students to persist during their studies and end up graduating with an engineering degree. Another construct studied in this research is the interactions between students from different origins. As the results show, there is segregation

on campus. There is also a perception of discrimination from foreign-born students, especially in those situations where they interact more with native-born students. These results are worrying as they suggest that prejudice and discrimination still exist on the engineering campus and that an inclusive and cohesive student body is not being achieved. Therefore, institutions and all university personnel must take action and implement actions to eliminate the unfair and unequal treatment that foreign-born students may be receiving. Among other actions, the institution should establish a commitment of zero tolerance to discrimination and harassment towards students and should promote awareness among the community, for example, by promoting courses, workshops, and lectures to raise consciousness about unconscious biases and implicit stereotypes, which often cause discrimination in academic environments. In addition, teachers should also be trained to be capable and have tools to structure cooperative learning activities and pay more attention to diversity within the classroom so that discrimination among students no longer occurs.

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