Fostering Leadership and Gender Equity Through Student Groups: A Case Study in Engineering Education

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Abstract*– One of the challenges of higher education is to achieve gender equity in the areas of Science, Technology, Engineering and Mathematics (STEM), from enrollment, retention to graduation. Universities develop different actions to impact this challenge, through strategies, policies, and initiatives, all conducted by their professors, leaders and students. This research has a qualitative approach, which aims to present a case study at a School of Engineering, that has as a strategic initiative to increase the percentage of women in STEM areas. The research focuses on the involvement of students in promoting the strengthening of this gender equity initiative through student groups, analyzing: the approach of the university in relation to student groups and gender equity as a context, analysis of the academic programs that integrate it with its students by gender, the purposes of each student group linked to these initiatives in STEM area and the opinion of candidates for graduation in relation to the activities of student groups. The results show that student groups focused on equity aim to create a supportive and empowering environment through various activities. Despite positive evaluations from graduating students, there are still gender participation gaps in engineering fields. Both the institution and the engineering school should enhance initiatives to meet the common goals of these groups.

Keywords—Women in STEM, Higher Education, Educational Innovation, Gender Equity, Women's Networks.

I. Introduction

A fundamental challenge in higher education worldwide is achieving gender equality and promoting leadership development through increased women's participation. While there has been an increase in female enrolment in Science, Technology, Engineering, and Mathematics (STEM) fields, the representation of women in engineering programs, as well as leadership positions in technology companies and industries, remains lower than that of men [1]. It is necessary to correct this discrepancy, so objective actions are required that, in addition to encouraging participation, promote leadership skills needed for the professional advancement of gender in the medium and long term.

In this scenario, student groups stand out, having become, in various ways, effective mechanisms to re-dimension leadership competencies and promote inclusive practices for long-term sustainability. For example, participation in professional engineering organizations, among other strategies, provides essential social capital, as it improves retention and, above all, promotes the integration of underrepresented students into engineering communities [2]. In addition, planned interventions in the formation of study groups, particularly those that prioritize inclusivity, have demonstrated their ability to enhance the quality of collaboration, encourage equitable participation in large-scale courses, and promote gender balance [3].

On the other hand, it is essential to note that the formation of teams significantly impacts leadership behaviours in engineering education. Some research indicates that teams composed exclusively of women tend to exhibit more significant levels of seeking help and establishing proactive communication strategies. This results in a notable correlation with the development of leadership skills and techniques, as well as the enhancement of competencies in the participants [4].

However, caution must be exercised, as discriminatory practices in student organizations—ranging from stereotypes and preconceived images to biased socialization and exclusion from decision-making—continue to affect leadership self-efficacy among female students [5]. These findings underscore and amplify the importance of designing student group structures that actively promote equity and inclusion, for the purposes indicated. Beyond individual student outcomes, the broader academic and institutional effects of fostering gender equity and leadership are considerable.

Therefore, inclusive student groups contribute to the creation of collaborative environments and scenarios that support innovation, enhance peer learning, develop necessary competencies, and reinforce academic persistence, especially in disciplines where women and minority groups remain underrepresented [2], [3]. These scenarios, with the characteristics described, align with the international calls for sustainable educational practices that prioritize integration, equity, diversity, and social responsibility as fundamental values of engineering education [1].

In addition, preparing engineering students to take on leadership roles in diverse teams is increasingly essential to address complex, ethical, and multidisciplinary challenges. To this end, companies and professional organizations emphasize, among other ideas, the importance of leadership, communication, and inclusive teamwork, highlighting them as key competencies for success in the global labour market [4].

Incorporating these competencies into student groups not only benefits individual career paths but also reinforces institutional and organizational commitment, fostering diversity and excellence.

This document examines how structured student groups can function as vehicles to promote gender equity and leadership development within undergraduate engineering programs. By analysing group dynamics and perceived outcomes, the research contributes to the ongoing debate on strategies for creating inclusive academic environments. The results highlight the potential of student groups to transform institutional culture, while aligning with global goals for diversity, equity, and inclusion in higher education.

II. Literature Review

Achieving gender equality in engineering is a global priority (as reflected in UN Sustainable Development Goal 5), yet women remain significantly underrepresented in STEM fields. Worldwide, only about 35% of higher education STEM students are female, and the gap is even wider in engineering and computing disciplines [6]. In Latin America, this disparity is pronounced; for example, in Mexico, there are only 45 women enrolled in engineering for every 100 men, and in computer science, the ratio is about 31 women per 100 men [6]. Likewise, women comprise roughly 20% of STEM jobs in Mexico (a 4:1 male-to-female employment ratio). These statistics underscore the persistent gender gap and the need for proactive measures to support women's participation and success in engineering programs [7].

Researchers emphasize that a multifaceted set of factors underlies the gender gap in engineering, including cultural stereotypes, gender biases, and a lack of female role models or mentors in the field. Traditional engineering program cultures have often centered on majority (male) norms, which can leave women and other minoritized groups feeling like outsiders. Studies have found that women in STEM frequently encounter "hegemonic masculinity" or "bro-culture" in academic settings that marginalize them [8]. Common challenges range from subtle biases and doubts about women's capabilities to more overt discrimination, all of which can erode confidence and belonging. As a result, many women in engineering report lower self-efficacy and a sense that they must "prove themselves" more than their male peers [9]. These issues underscore the importance of intentionally cultivating a more inclusive culture within engineering education – one that values women's contributions, fosters supportive networks, and actively counters stereotypes.

Educational institutions in Latin America and beyond have begun implementing initiatives to cultivate such an inclusive culture of gender equity, often by empowering students themselves to take the lead. Universities "should not be distant from this environment", they play a critical role in advancing gender equity through programs that engage their communities [10]. A recent survey of Latin American STEM initiatives highlights both campus-level programs and multi-institutional networks devoted to this cause. For example, Ingenia: Women in Engineering and Science at Tecnológico de Monterrey (Mexico) and the Matilda Latin American Open Chair for Women in Engineering network are cited as key programs promoting women's inclusion in STEM in the region [11]. These initiatives organize mentorship programs, workshops, panel discussions, and other activities that raise awareness and provide support for women in the field of engineering. Notably, they also encourage the involvement of men as allies to create a more equitable environment together [6]. The underlying strategy is to "strengthen the culture of gender equality, create safe spaces and opportunities for the development of women" – ultimately normalizing the idea that women belong in all areas of engineering. By changing organizational culture and leadership structures to be more inclusive, these efforts aim for a transformative, long-term impact.

One powerful avenue for change is the formation of student-led organizations dedicated to promoting gender equity in the field of engineering. Research indicates that these student groups and chapters of professional societies serve as necessary "counterspaces" that buffer women from the exclusionary aspects of the dominant culture [8]. They create a supportive micro-community where members feel valued, "safe, and validated" by each other's experiences. For instance, interviews with 55 women and underrepresented minority engineering students in the U.S. found that participation in identity-focused professional engineering organizations (PEOs – such as the Society of Women Engineers or NSBE) significantly improved students' feelings of fit and belonging in their programs. These organizations foster a sense of family or camaraderie, allowing students to bond over shared experiences and find mentors/role models who have succeeded in similar circumstances. One Latina engineering student described that joining a women-in-engineering group made the environment feel "more inclusive," helping her realize "I belong here" despite the male-dominated atmosphere. Such outcomes are common – even women who don't personally join these groups acknowledge that they can encourage and "be helpful if you're struggling being a woman in engineering" by providing a support system. In short, student equity organizations function as affirming spaces that counteract feelings of isolation. They reinforce members' engineering identity (the sense that "I am an engineer") and commitment to persist in the field. Indeed, prior studies have found higher retention and graduation rates among underrepresented students who engage in these societies, attributed to the emotional and peer support they offer [7].

In addition to enhancing a sense of belonging, involvement in these student groups helps participants develop valuable skills and leadership competencies. Organizing events, workshops, outreach activities, or mentorship programs through a club provides students with hands-on experience in teamwork, communication, and project management. Female engineering students who assume

leadership roles in women-in-STEM organizations often report increased confidence and enhanced leadership effectiveness. For example, one study of a women's engineering leadership program noted that senior students who mentored younger peers improved their communication, planning, and teamwork skills, recognizing their own "skills and worth" while developing as leaders. Similarly, the Frontiers in Education study on PEOs observed that students "developed leadership and time management skills" through their experiences in these organizations. Taking on a chapter officer position, heading a project, or coordinating a conference can be a transformative experience. Participants gain professional networking opportunities and learn to navigate organizational dynamics, which translates into career preparation. One student leader reflected that serving as a chapter chair was "a great experience – it gets me experience being a leader," noting that employers were impressed with her extensive involvement and leadership during college. These opportunities to practice leadership in a supportive, mission-driven context are especially impactful for women, who may not often see themselves represented in traditional engineering leadership roles. In essence, student equity groups serve as incubators for inclusive leadership skills, empowering students to become advocates and change agents for diversity in their future workplaces. This aligns with the broader call in engineering education to train future engineers not just in technical skills, but also in inclusive leadership and teamwork, so that they can foster environments "where everyone feels affirmed and valued" in the profession.

Crucially, the benefits of these groups extend beyond the individual participants; they also catalyze cultural change within the institution. As women (and male allies) collaborate in equity-focused initiatives, they raise awareness among their peers and faculty, helping to slowly chip away at biases and norms that perpetuate the gender gap. Many groups engage in outreach to younger students, often referred to as "women helping other young women," which creates a ripple effect of empowerment and challenges stereotypes in the broader community [11]. Over time, the presence of active women-in-engineering or gender alliance organizations sends a message that inclusion is a priority and an integral part of the engineering school's identity. It encourages a new generation of engineering leaders – both female and male – who are conscious of equity issues and experienced in addressing them. Research from Latin America highlights that collective efforts, particularly when backed by institutional commitment, can shift attitudes and enhance the climate for women in STEM. In Latin American universities, initiatives like mentorship programs for high school girls, networking events, and leadership development workshops have shown positive preliminary outcomes in boosting girls' interest in engineering and instilling social responsibility in undergraduate mentors. These successes reinforce the idea that achieving accurate gender equity requires a cultural transformation – one propelled by engaged students, educators, and partners working together.

In summary, cultivating leadership competencies and fostering a culture of gender equity in engineering programs go hand in hand. Student-led gender equity organizations provide a potent vehicle for both objectives: they empower participants with leadership experience and a professional network, while also creating inclusive communities that improve persistence and a sense of belonging for women in engineering. Especially in Latin America, where the need for women's representation in engineering is pressing, such groups (often supported by larger networks and institutions) are spearheading change. They embody a grassroots approach to culture change – one that complements top-down policies and faculty efforts by directly engaging students as drivers of inclusion. As the literature suggests, when women and allies "join forces" through these organizations, they can redefine the norms in engineering education, making equity and diversity core values of the community. Investing in these student initiatives and integrating their lessons into the broader curriculum can help ensure that future engineers not only possess technical acumen, but also the inclusive leadership skills and mindset needed to transform the field into one where all talent can thrive.

III. Methodology

This work presents a case study in the context of an Engineering School of a Latin-American university, focusing on the involvement of female engineering students in student groups dedicated to promoting the participation of women in STEM. These groups serve as platforms for students to develop leadership competencies while fostering a culture of gender equity within the university and the broader community.

The analysis begins by providing the context in which the student groups operate, with the culture of values and principles that the institution seeks to develop in its academic community, in particular the issue of gender equity and inclusion. The next step is to provide an overview of the Engineering School, including its total student population, academic offerings, and gender distribution across its engineering programs. It then describes the current student groups with a focus on gender equity, outlining their main objectives, number of members, academic disciplines represented, key activities, and main achievements. Finally, the study presents the outcomes and lessons learned from these initiatives (see Fig. 1).

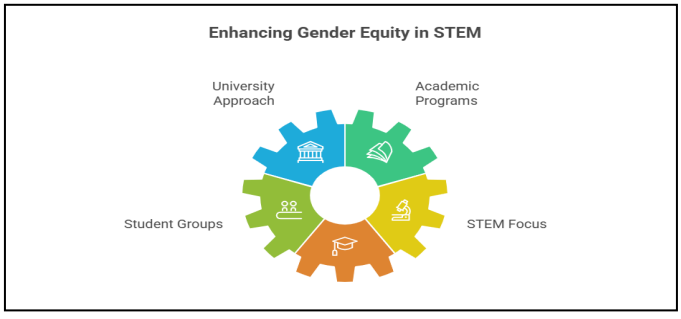

Fig. 1 Case study elements

As of the latest academic term (Spring 2025), the Engineering School at the university hosts 7,440 students at its main campus, of whom 30% are women. The school offers 17 engineering programs, with two additional programs delivered entirely in English (1. Industrial and Systems Engineering, and 2. Mechatronics Engineering). Table I shows the engineering programs offered at the Engineering School, as well as the Acronyms by which these programs are identified. Gender distribution varies significantly among the different engineering programs, as the next section describes.

TABLE I
ENGINEERING PROGRAMS

Program Name	*Acronym*
Biomedical Engineering	IMD
Biotechnology Engineering	IBT
Business Digital Transformation Eng.	ITD
Chemical Engineering	IQ
Civil Engineering	IC
Computer Science and Technology	ITC
Data Science and Mathematics Eng.	IDM
Electronics Engineering	IE
Food Engineering	IAL
Industrial Physics Engineering	IFI
Industrial and Systems Engineering	IIS
Industrial and Systems Engineering - English	BIE
Innovation and Development Eng.	IID
Mechanical Engineering	IM
Mechatronics Engineering	IMT
Mechatronics Engineering - English	BME
Nanotechnology Engineering	INA
Robotics and Digital Systems Eng.	IRS
Sustainable Development Eng.	IDS

IV. GENDER ENROLLMENT IN THE ENGINEERING SCHOOL (EIC)

Women representation at the Engineering School is 30% of the total student population. However, gender enrollment in the different academic programs varies across disciplines. Incoming engineering students at our university have four options to start their first two or three semesters. These options are called “avenues” and are Innovation and Transformation (IIT), Bioengineering and Chemical Processes (IBQ), Computer Science and Information Technologies (ICT), and Applied Sciences (ICI). Table II shows the enrollment and gender representation in these avenues.

TABLE II
GENDER ENROLLMENT IN THE ENGINEERING AVENUES

Acronym	*Total population*	*Female (%)*	*Male (%)*
IIT	907	26	74
IBQ	262	56	44
ICT	254	24	76
ICI	166	33	67

On the second year of the engineering studies, students choose a specific program within their avenue to continue their education. Table III details the gender enrollment in the engineering programs at our university.

TABLE III
GENDER ENROLLMENT IN THE ENGINEERING SCHOOL

Acronym	*Total population*	*Female (%)*	*Male (%)*
IMD	365	48	52
IBT	341	60	40
ITD	181	27	73
IQ	463	47	53
IC	398	17	83
ITC	779	19	81
IDM	309	28	72
IE	68	15	58
IAL	116	78	22
IFI	239	23	77
IIS	764	26	74
BIE	123	43	57
IID	149	39	61
IM	467	15	85
IMT	469	16	84
BME	117	24	76
INA	253	39	61
IRS	155	21	79
IDS	94	53	47

V. STUDENT GROUPS

In recent years, the promotion of diversity, inclusion, and gender equity has become a strategic priority for higher education institutions worldwide. STEM disciplines (Science, Technology, Engineering, and Mathematics) have traditionally

been spaces where women and other historically underrepresented groups have faced structural barriers to full participation. In response, many universities have launched initiatives aimed at transforming their institutional cultures by fostering more equitable, accessible, and representative academic environments.

In Mexico, one private university has played a significant role in this effort by incorporating student-led initiatives within their academic communities. The university has an area dedicated to ensuring that the student's extra-academic experience is rich in variety and complementary to their education in their curriculum, where they can develop leadership and personal competencies and learn the significant impact of their actions and the application of their discipline on the environment. This area is known as LIFE (Student Leadership and Education, "Liderazgo y Formación Estudiantil").

These student groups—formed by young individuals committed to social justice and cultural change—have emerged as key actors in advancing gender equity, promoting respect for diversity, and creating safe, inclusive spaces within STEM fields. Through projects, campaigns, workshops, and awareness-raising activities, these collectives seek to bring visibility to systemic challenges, challenge prevailing stereotypes, and generate opportunities for all individuals, regardless of gender, identity, or background.

This section presents and describes several of these student groups, outlining their objectives, organizational principles, and the specific actions they carry out within a private Mexican university. By doing so, this paper aims to highlight the positive impact of such efforts in building more just and inclusive academic communities, while also reflecting on the critical role students play in driving cultural transformation within educational institutions.

A. AIRE

A community that actively advocates respect, protection, and preservation of the rights of social minorities, while promoting the creation of inclusive spaces free from stereotypes and discrimination. It fosters a culture of respect and normalization toward the diversity of the LGBTIQ+ community.

Among the activities promoted by the student group AIRE are inclusion forums, discussion panels, conferences, workshops, support networks, and events related to the LGBT community.

B. GirlUp

To empower and support women within a safe environment by providing access to information and fostering strong support networks. The group promotes awareness of gender equality and human rights, encouraging community reflection on leadership, well-being, and social justice. It also seeks to strengthen solidarity among women and promote their personal and professional development.

As part of the activities organized and led by the student group Girl Up, the group hosts conferences, discussion forums, testimonial talks, and well-being activities for women. A key aspect of this student group is that all participating students receive social service credit, fulfilling a graduation requirement established by the university.

C. Musa

A student group that seeks to support female students across all health-related fields, while also raising awareness about important issues concerning women and their well-being.

The student group MUSA focuses its efforts on organizing activities that promote and support women's health. Among its most representative initiatives are "Health Week" and well-being sessions, primarily including yoga and mindfulness practices.

D. Sacbé

To create informative and safe spaces for women in STEAM fields, and to eliminate gender bias across various branches of the professional sciences through awareness-raising and intentional education.

Sacbé is one of the most recognized student groups supporting gender equity in STEM fields and is a preferred option among students for contributing social service hours to their professional curriculum. Among Sacbé's most notable activities are the organization of mentorship programs for high school students in vulnerable situations, conducted by students from the university's School of Engineering and Sciences. Additionally, the group organizes workshops, conferences, awareness-raising activities, and campaigns focused on the role of women in STEM fields.

E. Women in Science & Technology (WIT)

A student group dedicated to the empowerment of women in science, aiming to ensure that girls and women feel supported throughout their journey in scientific careers, while also encouraging more women to pursue paths in STEM (Science, Technology, Engineering, and Mathematics).

The student group WIT is a pioneer in promoting women in STEM, with a particular focus on Information Technology. As part of its work plan, the group notably organized the First International STEM Women's Summit, as well as the first STEM Hackathon exclusively for women. Additionally, WIT conducts activities such as programming and robotics workshops, panels, conferences, and networking sessions connecting students with industry leaders.

The university has a survey that is administered in the final semesters of a student's engineering studies to gather their opinions on their experience throughout their studies, particularly their experience with student groups. Each semester, graduating students complete an exit survey known as ECAG. This instrument includes multiple areas of evaluation such as teaching experience, interaction with the program director, campus facilities, and administrative

services, among others. Importantly, it also assesses students' experiences in student groups.

The results from February to June of the last three years, covering the 17 programs within the School of Engineering and Sciences, are presented in Table IV. Using a Likert scale from 1 to 10, where 1 indicates a very poor experience and 10 indicates an excellent one, the overall average score was 8.4 from June 2023 to June 2025 (five cohorts). Table IV compares graduating cohorts in the February and June semesters from 2023 to 2025. According to the established scale, over 60% of graduating students rated their experience with student groups as 9 or 10.

TABLE IV
EVALUATION OF STUDENT GROUPS EXPERIENCE

Program	*Feb-Jun 23*	*Feb-Jun 24*	*Feb-Jun 25*
EIC	51.1%	63.9%	61.5%
IAL	61.5%	64.0%	56.0%
IBT	48.9%	58.2%	66.0%
IC	41.7%	61.4%	64.6%
IDM	44.4%	54.1%	67.4%
IDS	54.3%	80.0%	58.8%
IE	30.0%	45.5%	62.5%
IFI	54.5%	61.1%	46.3%
IID	55.6%	67.6%	61.3%
IIS	46.4%	59.8%	68.8%
IM	50.0%	60.0%	55.0%
IMD	64.2%	70.0%	71.8%
IMT	55.8%	63.1%	66.3%
INA	66.7%	72.7%	48.9%
IQ	45.1%	77.8%	62.5%
IRS	53.8%	69.2%	64.3%
ITC	48.0%	64.0%	55.3%
ITD	37.5%	43.8%	67.9%

VI. DISCUSSION AND CONCLUSIONS

As part of the efforts to create a culture of values and principles and align with the Sustainable Development Goals, guidelines and processes have been developed to strengthen student participation. These guidelines and processes encourage students to develop personal competencies and leadership skills through student groups. There is still a significant difference in the percentage of female and male students in the School of Engineering, which is why actions have been strengthened through faculty and students. Participation in student groups that promote women's vocations in STEM disciplines helps reduce the perception of male dominance and biases about capabilities in engineering careers according to gender [8,9]. These student groups reinforce a safe and validating environment, which helps retain these vocations during engineering studies [7, 8]. Interestingly, the five student groups aim to create a culture and safe spaces. They also seek to support women in their discipline and personal growth.

However, as the numbers show, there is still a significant gender gap in some engineering programs that are considered more "hardcore" disciplines. Similarly, the candidates' opinions regarding the student groups reveal an area for improvement. This should prompt the institution and the engineering school to collaborate more closely with professors, directors, support staff, and students (both men and women) to foster a culture of equity and inclusion that promotes the growth of young people, organizations, and society. Another strategy to consider is industry engagement, which seeks to increase the presence of women in STEM and supports initiatives in universities, including mentoring programs between women in industry and undergraduate women students.

Future studies should analyze student participation in these groups by academic program, as well as the factors that lead students and faculty to commit to these objectives, to define initiatives to increase the participation of both students and faculty in these student groups. As recommendations, the analysis of other metrics such as terminal efficiency and integration into the labor market could be considered to observe the impact upon graduation and thereafter. These activities will increase participation, vocations, retention, and the percentage of women in STEM areas. Both men and women can serve as models of inspiration for academic and professional leadership in creating a just, safe, sustainable, and equitable society.

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