Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #49452

A Decade of Research on Women in Engineering: A Systematic Mapping Study

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

Monica Quezada-Espinoza is a professor and researcher at the School of Engineering at Universidad Andrés Bello in Santiago, Chile, where she collaborates with the Educational and Academic Innovation Unit (UNIDA) as an instructor in active learning methodologies and mentors engineering faculty in educational research. She is the Secretary of the Women in Engineering Division (WIED) of the American Society for Engineering Education (ASEE) and an associate researcher in the STEM Latin America Network, specifically in the STEM + Gender group. Her research interests are diverse and focus on university education in STEM fields, faculty and professional development, research-based methodologies, and the use of evaluation tools and technology for education. She is also passionate about investigating conceptual learning in abstract physics topics, developing strategies to improve the retention of first-year engineering students, and enhancing skills and competencies in higher education. Additionally, Monica is dedicated to exploring gender issues in STEM education, with a particular emphasis on studying and proposing improvements for the inclusion of women in highly male-dominated fields. For more information on her work, visit her ORCID profile.

Prof. Angeles Dominguez, Tecnologico de Monterrey, Monterrey, Mexico (ITESM); Universidad Andres Bello, Santiago, Chile (UNAB)

Angeles Dominguez is a researcher at the Institute for the Future of Education at Tecnologico de Monterrey, Mexico. She also collaborates with the School of Engineering at the Universidad Andres Bello in Santiago, Chile. Angeles holds a bachelor's degree in Physics Engineering from Tecnologico de Monterrey and a doctoral degree in Mathematics Education from Syracuse University, NY. For her research, she is Researchers' National System in Mexico (Level 2), Associate Editor of the Ibero-American Journal of Learning Technologies (IEEE-RITA), and a guest editor for the journals Education Sciences, Frontiers in Education, and Discover Sustainability. Her main research areas are: interdisciplinarity in science, gender studies in STEM, and faculty development. Due to her interest in women's participation in science, she has been a mentor in several programs, received the Mentor in Science distinction from the British Council Mexico, and coordinates mentoring program at the Tecnologico de Monterrey and at Universidad Andres Bello. Angeles leads projects on gender studies in STEM, mathematical and interdisciplinary modeling, and teacher training.

Prof. Genaro Zavala, Tecnologico de Monterrey, Monterrey, Mexico; Universidad Andres Bello, Santiago, Chile

Dr. Genaro Zavala is Associate Director of the Research Laboratory at the Institute for the Future of Education, Tecnológico de Monterrey. He collaborates with the School of Engineering of the Universidad Andrés Bello in Santiago, Chile. A National Researcher Level 2 (SNI-CONACYT), he has over 20 years of experience in educational research. His work spans conceptual understanding in physics, active learning, AI in education, and STEM interdisciplinarity. He leads initiatives on faculty development, competency assessment, and technology-enhanced learning. With 100+ publications, he integrates educational psychology, digital transformation, and sustainability. Dr. Zavala also pioneers projects using neuroscience tools and learning analytics to improve student engagement and foster innovative, student-centered learning environments.

A Decade of Research on Women in Engineering: A Systematic Mapping Study

Abstract

This study presents a systematic mapping of research published in the ASEE's Women in Engineering Division (WIED) proceedings over the past decade (2015–2024). The primary objective is to provide a comprehensive overview of research trends and identify the key focus areas within this community, specifically addressing topics related to women's participation in engineering education. The study examines the distribution of publications over time (n = 337 in a 10-year period), the most influential works, the leading countries and institutions contributing to this research, the educational contexts explored, and the dominant research lines in the field. The methodology involves a systematic mapping approach, categorizing studies based on their focus, type (e.g., empirical research, literature reviews), and contribution to educational innovation, diversity, and gender equity. By systematically analyzing trends and contributions, this study aims to highlight gaps, opportunities, and advancements in the field of women in engineering education. The expected outcomes include identifying research patterns, prominent lines of inquiry, and areas requiring further exploration to support the inclusion and success of women in engineering. This mapping provides a clearer understanding of how the research community has approached these issues and offers guidance for future work aimed at reducing the gender gap and promoting equity in STEM education and professional environments.

Keywords: Women in engineering, systematic mapping, SLR, engineering education, research trends

Introduction

The underrepresentation of women in engineering remains a critical challenge in both educational and professional contexts, despite significant advancements in policies and initiatives to narrow the gender gap in Science, Technology, Engineering, and Mathematics (STEM) fields. This issue underscores structural inequalities and restricts access to the diverse talent pool essential for addressing today's complex engineering problems. Against this backdrop, research on women's participation in engineering education has gained increased attention, particularly through specialized forums such as the Women in Engineering Division (WIED) of the American Society for Engineering Education (ASEE), which is dedicated to advancing gender equity in this domain.

This growing focus on women's participation in engineering education is exemplified by the Women in Engineering Division (WIED) of ASEE, which serves as a platform for research dissemination and actively addresses the needs of women and gender minorities in engineering and engineering education. The Division fosters a diverse and inclusive community, recognizing that varied perspectives and experiences enhance creativity and drive meaningful innovation. Through its initiatives, WIED is committed to promoting diversity, equity, and inclusion while addressing critical challenges such as recruitment, retention, persistence, and graduation within engineering, engineering technology, and related

fields. The Division also welcomes allies who share their mission, emphasizing the importance of collective efforts to advance gender equity [1].

Despite significant progress in scholarships over the past decade, further analysis is needed to understand trends and guide future efforts effectively. This study systematically maps research published in the WIED proceedings from 2015 to 2024 to address these questions. By identifying trends, patterns, and key contributions, it aims to provide a foundation for guiding future research and strategies to enhance the inclusion and success of women in engineering education. This synthesis highlights unexplored areas, emerging opportunities, and necessary advancements to reduce the gender gap and foster equity in engineering education and practice.

Method

This study follows the systematic mapping process outlined by [2]. The five steps defined by these authors are illustrated in Figure 1. A detailed description of each step is provided below.

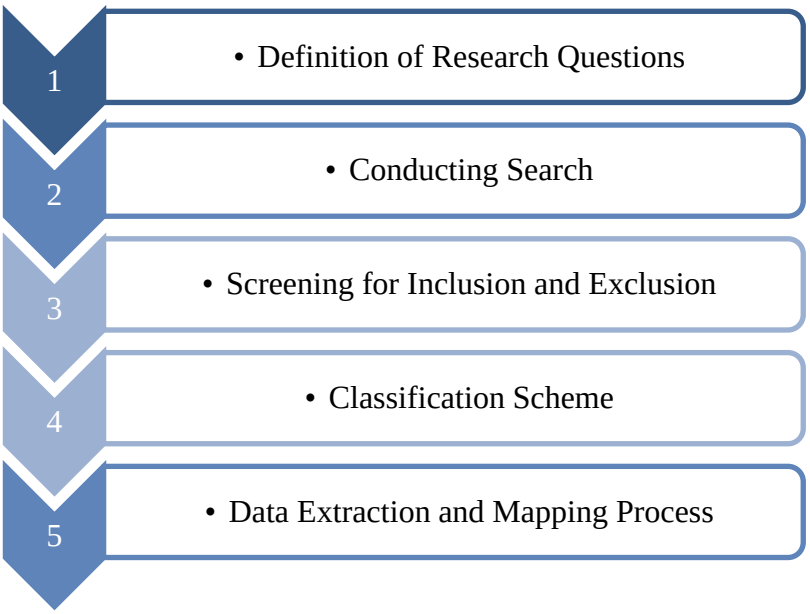

Figure 1. Systematic mapping process overview (Adapted from [2]).

Step 1. Definition of Research Questions

This systematic mapping study explores research trends and key contributions in the Women in Engineering Division (WIED) from 2015 to 2024. Table 1 presents the research and mapping questions guiding this study.

Step 2. Conduct search

For this systematic mapping, the primary studies were identified by analyzing articles indexed in Scopus and published within the Women in Engineering Division (WIED) proceedings of the ASEE Annual Conference. This targeted approach focuses exclusively on a central forum where research on women in engineering education is actively disseminated, ensuring relevance and consistency with the study's scope. The selection process leveraged

Scopus as the database to ensure comprehensive coverage and systematically identify relevant WIED publications.

Table 1. Research questions and their description.

Question	Description
RQ1: How are publications on women in the engineering division distributed from 2015 to 2024 in the ASEE?	1. Number of publications per year.
RQ2: Which publications have had the most significant impact in this area?	1. Most-cited publications. 2. Authors with the most publications.
RQ3: Which countries and institutions are the most active in research on women in engineering education within the ASEE conference proceedings?	1. Publications by country of affiliation of the first author. 2. Institutions with the highest number of publications.
MQ1: In what educational levels have the studies been conducted?	1. Educational levels (e.g., undergraduate, graduate, or K-12).
MQ2: What are the most frequent research lines in articles related to women in engineering education?	1. Main themes or research lines (e.g., curriculum development, teaching methodologies, diversity initiatives). 2. Types of studies (theoretical/conceptual or empirical).

Unlike studies that rely on complex search strings across multiple databases, this method narrows the scope to a single, specialized source. While this approach excludes articles published outside the ASEE proceedings, it ensures a comprehensive and detailed overview of the contributions made within this highly relevant division. Analyzing all articles published in the WIED proceedings from 2015 to 2024, this study explores research trends, themes, and key contributions to women in engineering education.

Step 3. Screening of papers for inclusion and exclusion

To ensure that only relevant studies contributing to the research questions were included in this analysis, clear inclusion and exclusion criteria were established:
Inclusion criteria:

- Publications from the Women in Engineering Division (WIED) proceedings of ASEE between 2015 and 2024.
- Studies addressing topics relevant to the objectives of this analysis, such as women's participation in engineering or related factors.

Exclusion criteria:

- Publications outside the ASEE collection.
- Studies do not belong to the WIED division.
- Posters not indexed in Scopus.

The selection and exclusion process were conducted in three stages, as shown in the flowchart:

1. Identification: During an initial search in the PEER database, 1,494 records were retrieved. Of these, 1,165 records were removed as they did not meet the basic criteria, including 240 works outside the ASEE collection, 915 not belonging to the WIED division, and 10 from sessions unrelated to WIED.
2. Screening: A total of 361 records were screened in detail. Eight additional records were excluded as they were part of panel sessions.
3. Eligibility: From the remaining 353 records, 16 were manually excluded. This included nine posters not indexed in Scopus and seven posters from years outside the analysis scope.

Finally, 337 works met the inclusion criteria and were selected for systematic review. This rigorous process ensures that the results reflect a comprehensive and accurate overview of the studies published in the WIED proceedings of ASEE over the past decade.

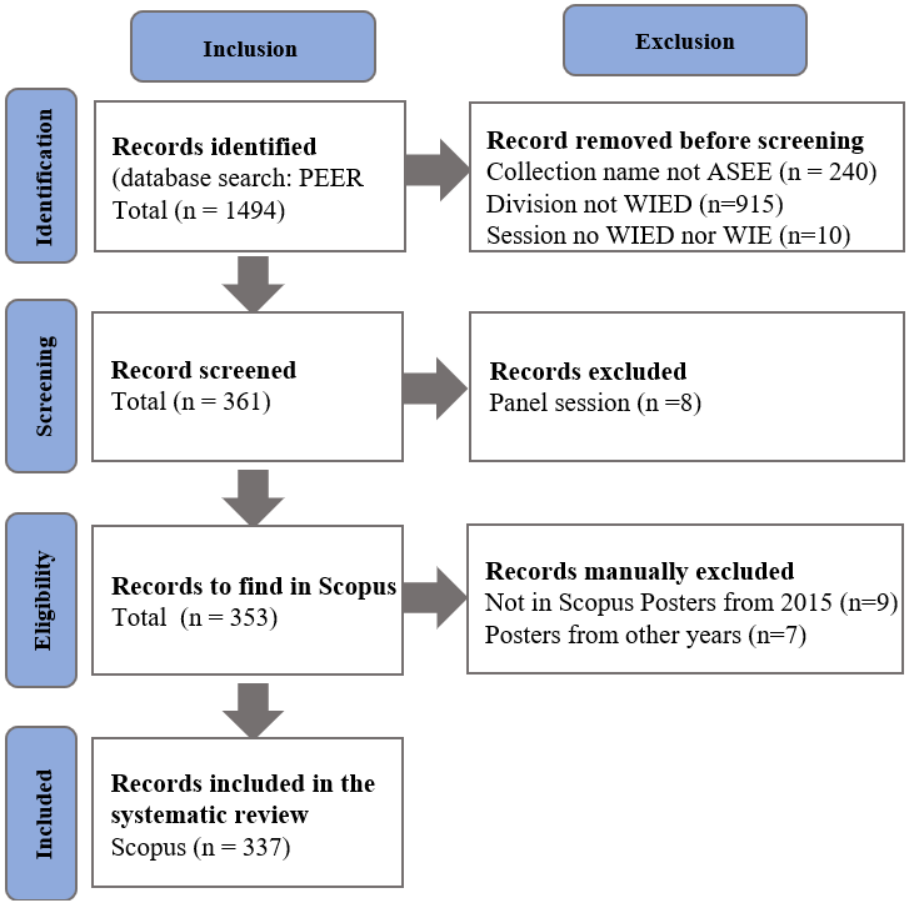

Figure 2. PRISMA flow diagram of the systematic review process indicating the inclusion and exclusion criteria and the number of records in each step.

Step 4. Classification Scheme

The categorization scheme used in this study was developed based on the classification framework established by [3]. Additionally, emerging categories not previously reported in the original scheme were identified and incorporated into the analysis. The categories employed in this study are summarized in Table 2.

Table 2. Categorization criteria for research questions.

Question	Construction Criterion	Categorization
RQ1, RQ2, RQ3, MQ1	Contexts of publications and implementations	Their respective contexts categorized them.
MQ2	Categorization of type of study based on [4] and [5].	• Empirical: studies based on experience or observations/implementations. • Theoretical/Conceptual: studies focused on abstract aspects or theory.
	Categories that emerged from the analysis, based on [3]	• Course, initiatives, practical implementations (mentoring, active learning, teamwork) • Broader perspective • Socio-cognitive factors • Persistence • Advancing women in engineering

The emerging categories identified in this study are described below, building on the framework proposed by [3]:

- *Courses, Initiatives, and Practical Implementations.* This category includes programs, courses, and initiatives designed to enhance women's engagement and success in engineering. It encompasses mentoring, outreach efforts, summer programs, professional development workshops, team-based learning approaches, inclusive teaching strategies, and institutional transformations aimed at fostering equity in engineering education.
- *Broader Perspective.* This category examines sociocultural, institutional, and structural factors influencing women's participation and advancement in engineering. It addresses systemic challenges such as gender bias, workplace climate, stereotypes, work-life balance, and the role of role models and institutional policies, offering a comprehensive lens on the barriers and opportunities that shape women's experiences in technical fields.
- *Socio-cognitive Factors.* This category focuses on psychological and social processes affecting women in engineering, including identity development, self-efficacy, motivation, and sense of belonging. It highlights the critical role of these factors in shaping women's experiences and outcomes in STEM education and careers.
- *Persistence.* This category explores factors that enable women to remain in and succeed within STEM fields. It emphasizes strategies that strengthen women's commitment to engineering education and careers, such as identity development, social support networks, and institutional efforts that mitigate barriers and ensure long-term success.
- *Advancing Women in Engineering.* This category investigates women's enrollment, retention, and success in engineering programs. It focuses on critical factors such as major choice, mentorship opportunities, and inclusive strategies to overcome systemic barriers and ensure women succeed in male-dominated fields.

Step 5. Data extraction and mapping process

The final step involved data extraction and mapping of the articles. The analysis was partially conducted using R for advanced data processing, while Excel was employed for organizing

and managing the database. Additionally, JASP 0.18.3.0 was utilized to perform specific statistical analyses. A total of 337 articles were analyzed. The database was constructed in Excel, organizing the articles with unique identification keys and including the categorizations necessary to address the research questions effectively.

Results

From the analysis of 337 articles, 888 authors contributed to this body of work, resulting in an average of 3.43 authors per article. Notably, 36 documents were authored by a single individual, indicating some variation in collaborative practices across the dataset. These articles contained 7,654 references, averaging 22.7 per document, demonstrating substantial engagement with existing literature in the field. Despite this, the average citation count per document was relatively low, at 1.65 citations, suggesting limited external impact or dissemination of individual works within the broader academic community. These findings highlight the collaborative nature of authorship in the division and potential opportunities to increase the visibility and influence of the research in this field.

A word cloud was generated from the titles of all articles in the dataset to visually represent the most frequently occurring terms in research published by the Women in Engineering Division (WIED) of ASEE over the past decade. As shown in Figure 3, prominent words such as engineering, women, gender, undergraduate, student, faculty, and impact stand out, reflecting this research community's core themes and focal points. Other notable terms include *diversity*, *retention*, *experience*, *program*, and *STEM*, highlighting a strong emphasis on equity, educational innovation, and student engagement in engineering education. These results indicate a consistent interest in addressing gender disparities, promoting inclusive practices, and fostering success for women in engineering contexts. The word cloud provides an accessible overview of the prevailing topics and highlights the division's dedication to advancing diversity and inclusion in STEM education.

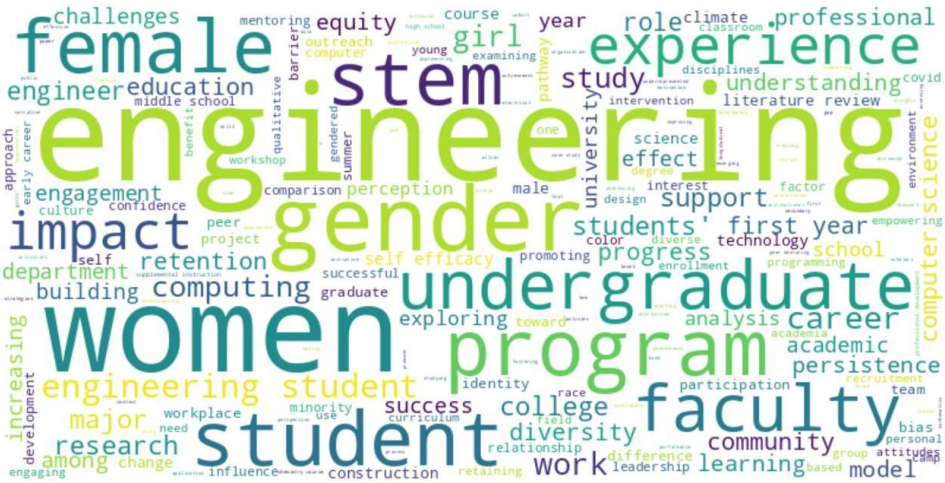

Figure 3. Word cloud of common terms in article titles from the Women in Engineering Division (WIED) proceedings (2015–2024).

To provide a comprehensive overview of the research published in the Women in Engineering Division, we addressed several mapping questions to uncover trends, themes, and contributions within this body of work. The following subsections present the results.

RQ1. Distribution across time

As shown in Figure 4, the distribution of publications within the Women in Engineering Division of ASEE from 2015 to 2024 demonstrates a generally consistent output, with annual fluctuations ranging between 30 and 45 papers. The highest number of publications occurred in 2020, with 43 papers. However, a significant decline was observed in 2022, with fewer than 20 papers marking the lowest point in the analyzed period. This drop is likely attributed to the global impact of the COVID-19 pandemic, which disrupted academic and research activities, resulting in reduced conference participation and publication output. In 2023, the number of publications increased, signaling a gradual recovery and a return to pre-pandemic levels of research activity and engagement within the academic community.

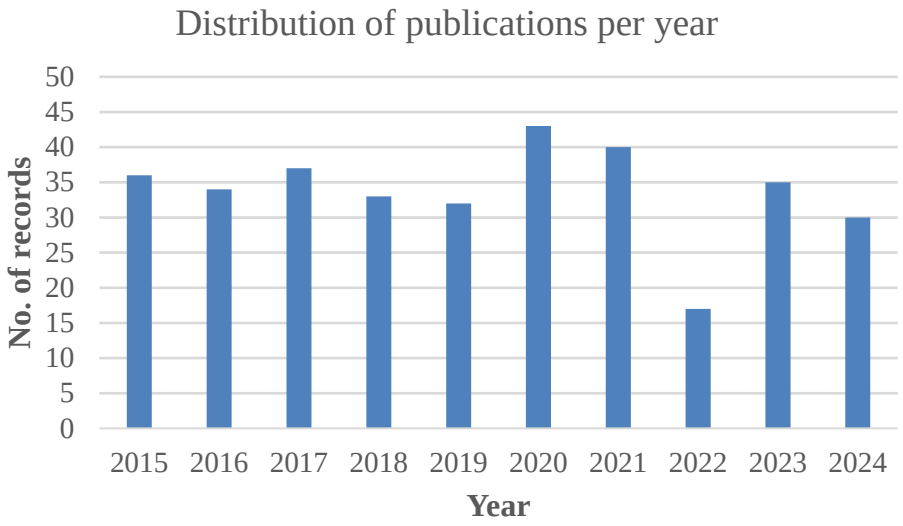

Figure 4. Distribution of research studies published in the Women in Engineering Division proceedings from 2015 to 2024.

RQ2. Impact of the WIED research

To assess the impact of research published within the WIED, we analyzed two key aspects: the authors with the most publications and the most cited papers. These metrics offer insights into the most prolific contributors and the influence of individual work within the research community.

Authors with the Most Publications. As shown in Fig. 5, the top 10 most frequent contributors to WIED proceedings include Rincon R. and Reisberg R., each with seven publications reflecting their prominent role in advancing research on women in engineering. Other prolific authors include Bailey M.B., who has contributed to six publications. The remaining authors— Ross L., Lucietto A.M., Zum-Birkhimer S., Ma G.G., Oka, L.G., Truyol M.E., and Kaeli E.—have five publications. These findings demonstrate key individuals' collaborative and sustained contributions to the division's research agenda.

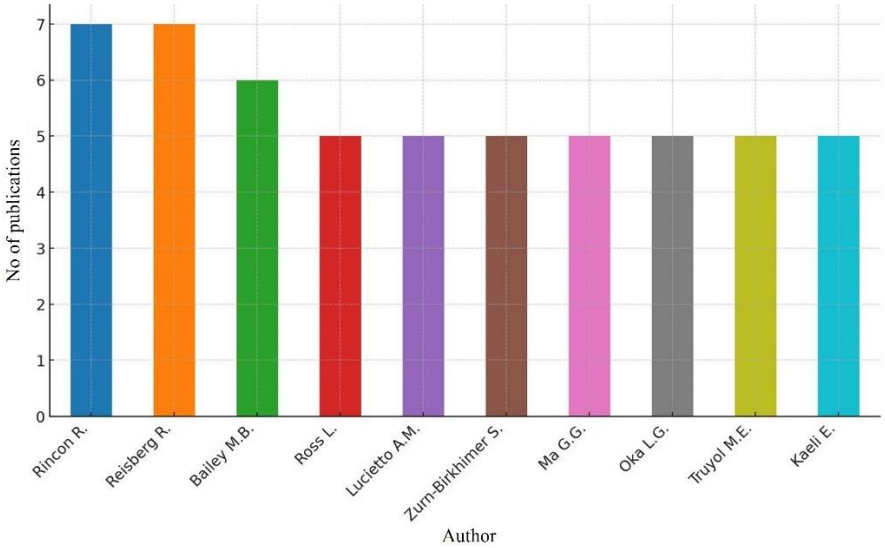

Figure 5. Top 10 most frequent authors in the Women in Engineering Division (WIED) proceedings (2015–2024).

Most Cited Papers. Figure 6 presents the top 10 most cited papers, offering insight into the research articles with the highest academic impact. The most cited paper, *Teamwork in engineering undergraduate classes: What problems do students experience?* by [6] received over 20 citations, highlighting its significant influence on the field. Other highly cited works include studies exploring gender differences in engineering careers, the inclusion of universal design in engineering education, and strategies employed by women in engineering to navigate hidden curricula. The consistent focus on themes such as gender equity, student engagement, and diversity across these influential papers underscores the WIED community's commitment to addressing systemic challenges and fostering inclusive practices in engineering education.

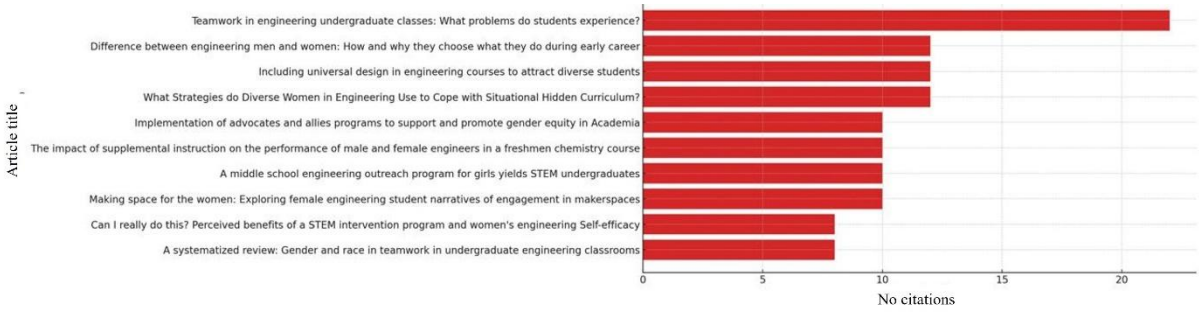

Figure 6. Top 10 most cited papers in the Women in Engineering Division (WIED) proceedings (2015–2024).

Together, these analyses highlight the key contributors and impactful research shaping the discourse on women in engineering while also identifying opportunities to amplify the visibility and influence of future work in this field.

RQ3. Countries and institutions more active in research on WIED

The most active institutions contributing to the Women in Engineering Division (WIED) proceedings from 2015 to 2024 are presented in Figure 7. Based in the United States, Purdue University emerges as the leading institution, with approximately 25 publications reflecting its significant focus on advancing research on women in engineering. Other notable

contributors include the University of Toronto in Canada and Universidad Andrés Bello in Chile, each with comparable publications highlighting international engagement in the field. Several U.S.-based institutions, such as the Wentworth Institute of Technology, Arizona State University, Kansas State University, and Pennsylvania State University, also stand out as frequent contributors. Additionally, Florida International University, the University of Florida, and the University of Delaware appear among the top institutions, further emphasizing the strong involvement of U.S. universities in this domain. These findings underline the collaborative efforts of both international and national institutions in promoting diversity and inclusion in engineering education.

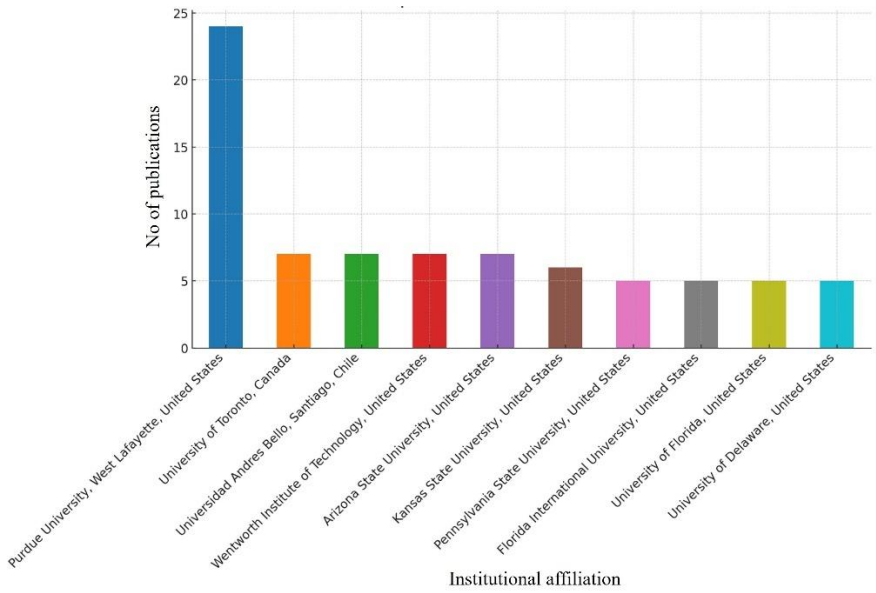

Figure 7. Top 10 most active universities or institutions contributing to the Women in Engineering Division (WIED) proceedings (2015–2024).

RQ4. Educational level and context

Figure 8 illustrates the distribution of research studies across various educational levels. Most studies focus on Undergraduates, accounting for 52% of the total. Faculty represents the second-largest category at 18%, followed by K-12 at 12%. Studies categorized under GAP (Graduate, Alumni, and Professional) account for 8%, while both Data and Many Grades represent 5% each. This distribution underscores the strong emphasis on undergraduate education in the analyzed research, with comparatively smaller proportions addressing other educational levels or combined grades.

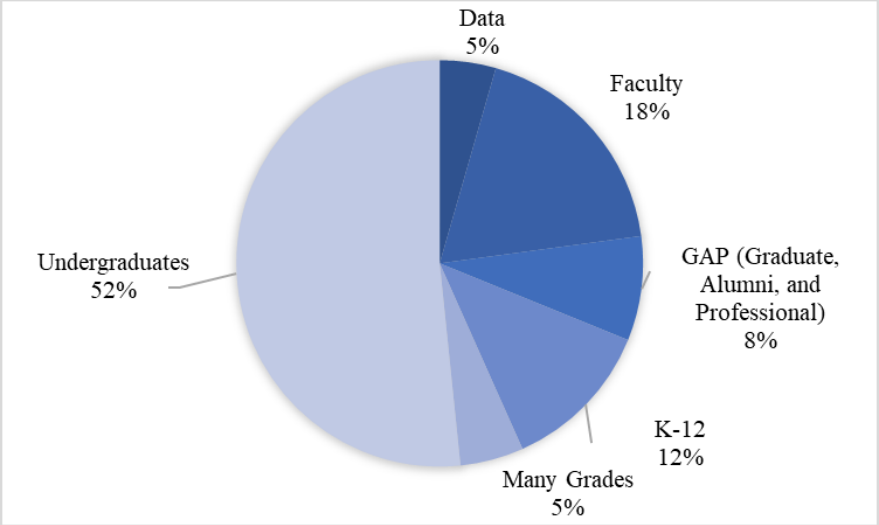

Figure 8. Distribution of research studies by educational levels.

The studies categorized under "Data" focus on analyzing and interpreting datasets related to diversity, inclusion, and gender representation in engineering and STEM fields. These studies aim to uncover systemic issues, institutional practices, and cultural dynamics that affect underrepresented groups, particularly women and minorities, in both academic and professional contexts. Employing diverse methodologies such as systematic literature reviews, institutional data analysis, and theoretical frameworks, these studies generate insights and propose actionable strategies for fostering equity and inclusion.

To further contextualize the research, Table 3 provides an overview of the proportion of studies that adopt an intersectional focus. This table offers additional insights into how various educational levels and contexts are addressed within the analyzed studies.

Table 3. Intersectionality in studies across educational levels and contexts.

	Intersectionality		
Educational Levels/Subjects	**Yes**	**No**	**Total**
Faculty	11	51	62
K-12	3	38	41
Undergraduate	22	152	174
Data	4	11	15
Graduate, Alumni, and Professional	4	24	28
Many Grades	1	16	17
Total	45	292	337

A total of 45 studies (13.4%) explicitly address intersectionality across various subjects and contexts. Among these, undergraduate-focused studies constitute the largest share, with 22 studies, followed by faculty-focused studies with 11. Graduate, alumni, professional studies, and data-focused research each contribute 4 intersectional studies, while K-12 contexts account for 3 studies. Studies spanning multiple grade levels include just 1. These intersectional works underscore the importance of examining overlapping identities within educational and professional environments, representing a focused yet relatively small portion of the broader dataset of 337 studies.

Table 4 strongly emphasizes "Courses, initiatives, and practical implementations," which account for 41.5% of the total studies and significantly focus on actionable strategies to promote gender equity. This is followed by "Broader perspective" (26.4%) and "Advancing women in engineering" (16.9%) as key areas of interest.

Mixed methods approach dominates the research methodologies, representing 48.4% of the studies, reflecting a preference for integrating qualitative and quantitative insights. Conversely, smaller categories such as "Persistence" (2.7%) and "Skills and engagement" (2.4%) reveal areas with comparatively limited investigation, suggesting opportunities for further research and exploration.

Table 4. Research approach distribution across emerging categories.

	Research approach			
Category	**Mixed**	**QUAL**	**QUAN**	**Total**
Advancing women in engineering	24	19	14	57
Broader perspective	32	30	27	89
Course, initiatives, practical implementations	86	35	19	140
Persistence	5	3	1	9
Skills and engagement	2	2	4	8
Socio-cognitive factors	14	13	7	34
Total	163	102	72	337

RQ5. Research Lines

The Methodology section describes the emerging categories based on the framework proposed by [3]. Figure 9 shows these categories, which provide the foundation for identifying and describing the most reported research lines in the articles published by WIED over the past ten years.

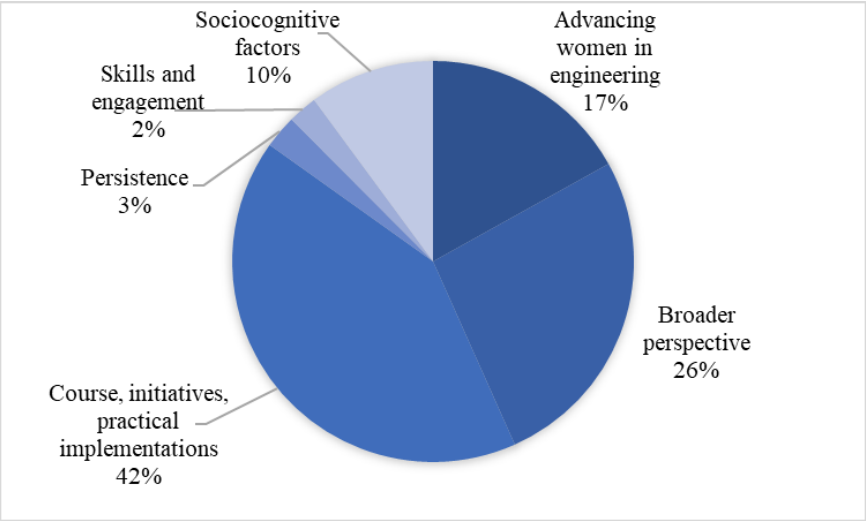

Figure 9. Distribution of research studies across emerging categories.

Each emerging category represents a distinct research line. The most representative category, *Courses, Initiatives, and Practical Implementations* (42%), encompasses a variety of subcategories, as detailed in Table 5. These subcategories include Programs (26%), Learning

Strategies (22%), Experiences (19%), Mentoring (17%), Workshops (7%), Outreach (5%), and Societies (4%). Each subcategory highlights specific focal points within practical applications and initiatives, showcasing the diverse strategies employed to promote gender equity and increase women's participation in engineering. This distribution reflects the breadth of effort dedicated to addressing challenges and fostering inclusion within the field.

Table 5. Subcategories within *"Course, initiatives, and practical implementations"*

Subcategories	**%**
Programs	26
Learning Strategies	22
Experiences	19
Mentoring	17
Workshops	7
Outreach	5
Societies	4

The *Broader Perspective* category is the second most representative, as illustrated in Figure 8, encompassing a wide range of research topics. The largest subcategory, External and Internal Factors (31%), comprehensively examines sociocultural, institutional, and personal influences on women's participation and success in engineering. Studies in this subcategory address structural constraints, diversity initiatives, social roles, early influences, and institutional policies.

The next subcategory, *Gender Bias* (26%), includes studies investigating systemic inequalities and gender bias within engineering education and professional environments. Other subcategories, representing smaller portions of this category, include Climate (15%), which examines issues like chilly climate; Workplace Situations (11%); Role Models (11%); and Stereotypes (6%). Together, these subcategories highlight the complex interplay of factors impacting women in engineering, offering diverse perspectives on the challenges and opportunities within the field.

Table 6. Subcategories within *"Broader Perspective"*

Subcategories	**%**
External and Internal Factors	31
Gender Bias	26
Climate	15
Work	11
Role Models	11
Stereotypes	6

The *Advancing Women in Engineering* category accounts for 17% of the analyzed articles. These studies primarily explore women's journey in engineering, focusing on key stages and strategies, as outlined in Table 7. The most prominent subcategory is Recruitment (32%), which examines initiatives and strategies designed to attract women to the field. This is followed by studies on Career Choice Experiences (21%), which delve into factors influencing women's decisions to pursue engineering. Other subcategories include analyses of Retention (19%), Enrollment Trends (16%), and Factors Contributing to Success (12%),

providing a comprehensive view of the pathways and challenges women face in entering, persisting, and succeeding in engineering disciplines.

Table 7. Subcategories within *"Advancing Women in Engineering"*

Subcategories	**%**
Recruitment	32
Experiences	21
Retention	19
Enrollment	16
Success	12

As illustrated in Figure 9, socio-cognitive factors account for 10% of the studies analyzed. Notably, nearly 90% of the subcategories within this group concentrate on research examining student identity, self-efficacy, sense of belonging, and motivation, underscoring their pivotal role in influencing academic and professional outcomes in engineering.

In summary, the analysis identifies four primary research lines within the WIED publications: (1) practical implementations and initiatives designed to increase women's participation through programs, mentoring, and learning strategies; (2) studies addressing systemic barriers such as gender bias, workplace climate, and institutional challenges; (3) research exploring the recruitment, retention, and success of women in engineering; and (4) investigations into socio-cognitive factors, including identity, self-efficacy, and sense of belonging, which shape women's experiences and outcomes in the field. These research lines highlight the multifaceted approaches to promoting gender equity in engineering education and careers.

DISCUSSION

The analysis revealed an average of 3.43 authors per paper, indicating a collaborative research culture within the Women in Engineering Division (WIED). Collaboration is essential in this field as it fosters the exchange of diverse perspectives, particularly when addressing gender equity in engineering, which requires interdisciplinary and multifaceted approaches. However, the presence of 36 single-authored papers highlights variability in collaborative practices. While single-authored works demonstrate the capacity for independent contributions, they may reflect limitations in opportunities for networking and team-based research, particularly for early-career researchers or those from underrepresented institutions. Future efforts should focus on fostering stronger research networks within WIED to enable more equitable access to collaborative opportunities, enhancing both the quality and diversity of contributions.

Purdue University emerged as the leading institution, with approximately 25 publications, demonstrating its central role in research on women in engineering. The prominence of U.S.-based institutions among the top contributors demonstrates the regional concentration of research within the WIED proceedings. However, international contributors, such as the University of Toronto in Canada and Universidad Andres Bello in Chile, highlight the growing global interest in gender equity within engineering education. The visibility of female role models and robust institutional resources, as evidenced in leading institutions, play a pivotal role in fostering productivity and inspiring participation in engineering research [7, 8]. This distribution underscores the importance of institutional resources and leadership

in driving productivity. Institutions with robust research infrastructures are more likely to lead in publishing, which raises questions about potential geographic and economic disparities. This observation aligns with recent findings by [9], who emphasize the importance of fostering equitable and international research collaborations to mitigate geographic and economic disparities in STEM research ecosystems.

Despite a substantial number of references per paper (22.7), the average citation rate of 1.65 per paper indicates relatively low impact or dissemination within the broader academic community. These results may reflect limited visibility of WIED proceedings beyond the ASEE audience or challenges in publishing in high-impact journals, which typically have a broader reach. This limited citation impact also echoes concerns raised by [9], who argue that knowledge production in behavioral and social sciences often reflects a narrow slice of global perspectives, leading to what they term "MASKing" (making assumptions based on skewed knowledge). In the context of WIED proceedings, the limited dissemination beyond ASEE may indicate a similar risk: a valuable body of research that remains largely invisible to global audiences, thus restricting its influence on broader discussions of gender equity in engineering. To counteract this, greater effort is needed to connect this scholarship with international research communities, increase the representation of diverse epistemologies, and promote inclusive authorship and dissemination practices.

The analysis revealed a strong focus on undergraduate education, representing 52% of the studies, with faculty (18%), K-12 (12%), and graduate/professional levels receiving comparatively less attention. This emphasis on undergraduate contexts aligns with the critical transition period when students' academic and career trajectories are shaped, making it an appropriate focal point for research efforts. It might be important to expand research even further to K-12 level and graduate and professional contexts that provide a more comprehensive understanding of the factors affecting women across the engineering education pipeline.

Courses, Initiatives, and Practical Implementations accounted for the largest share of studies (42%), highlighting the WIED community's focus on actionable strategies to promote gender equity. These studies often explore mentoring programs [10, 11], outreach activities [12], [13], and inclusive teaching practices [14], [15], directly impacting students' experiences and outcomes. The second most frequent category, *"Broader Perspectives,"* reflects the field's attention to systemic barriers such as gender bias [16], [17], workplace climate [18], [19], and institutional policies [20], [21]. Recent political developments, such as the rollback of diversity, equity, and inclusion (DEI) initiatives in some U.S. states under the current administration, have further intensified debates around institutional policies. These policy shifts pose significant implications for academic environments, potentially undermining long-standing efforts to address gender and racial inequities in engineering education.

While these themes dominate, some less explored areas, such as *Persistence* and *Socio-cognitive Factors,* represent growth opportunities. Persistent gender biases, harassment, and the lack of supportive environments in academic and professional contexts have been shown to significantly impact self-efficacy and sense of belonging among women in STEM [7], [22]. Kamalumpundi et al., [23] provides compelling evidence of how anti-DEI legislation and the politicization of diversity efforts threaten the structural supports necessary for inclusion in STEM fields. The dismantling of DEI centers, peer mentoring networks, and institutional initiatives has reduced access to environments that promote belonging and self-efficacy for underrepresented students. The authors argue that the erosion of these programs

exacerbates “toxic stress” and microaggressions—factors directly linked to diminished academic persistence and psychological safety. Moreover, they emphasize that without institutional commitments to inclusive mentoring and culturally relevant support systems, students from historically marginalized groups may experience intensified identity threats and alienation. These findings affirm that sociopolitical forces are not peripheral to student development—they are central to shaping educational experiences, particularly in fields like engineering, where minoritized identities remain underrepresented. Addressing socio-cognitive variables in research on gender equity must account for the shifting political landscape and its influence on campus climate and student outcomes.

At the same time, studies have shown that targeted participation in technical activities, such as hackathons and competitions, has demonstrated potential to boost confidence and reinforce women’s presence in engineering [8], [24]. Understanding these psychological and social processes, including identity development, could provide valuable insights into designing interventions that foster long-term success in STEM. Future research could delve deeper into these underrepresented areas to balance the focus between practical initiatives and foundational studies, addressing students' immediate needs and the structural barriers they face throughout their academic and professional journeys.

Only 13.4% of the studies explicitly addressed intersectionality, which examines how overlapping identities, such as gender, race, and ethnicity, shape individuals' experiences. While this represents an emerging trend, the relatively small proportion indicates a gap in the research, at least in what was published at the conference. Intersectionality is crucial for understanding women's challenges from diverse backgrounds and designing targeted interventions that address these complexities. For example, research highlights how overlapping identities can exacerbate barriers such as gender biases, discrimination, and limited access to resources, disproportionately affecting women from underrepresented or marginalized groups [25], [26]. By incorporating intersectionality, researchers can uncover disparities hidden in broader studies, such as the unique experiences of immigrant women, women of color, or those navigating additional socio-economic challenges. Expanding intersectional research is essential for designing tailored solutions that address these multifaceted barriers and foster equity and inclusion across all dimensions of identity within engineering education [27].
Täuber [28] provides compelling empirical support for this need, demonstrating that policy ineffectiveness in academia, manifested through harassment, discrimination, and institutional resistance, is more acutely experienced by women who differ from the majority on multiple identity dimensions. Her findings show that intersectional disadvantages are linked to lower levels of psychological safety and greater intentions to leave academic careers. She also cautions against the overuse of “weak” additive approaches to intersectionality, which fail to capture the' compounded and systemic nature of intersecting oppressions. These insights underscore that meaningful inclusion in engineering education demands acknowledging and rigorously analyzing the complex, interwoven structures of marginalization through robust intersectional frameworks.

Conclusions

This mapping study provides a valuable overview of a decade of research presented at WIED, revealing strengths, gaps, and opportunities that can shape the division’s future direction. It strongly emphasizes actionable strategies, undergraduate-focused interventions, and a growing but limited engagement with intersectionality, persistence, and socio-cognitive

factors. These trends show that while WIED has fostered important progress in practical gender equity efforts, there is still substantial room to deepen and broaden the scope of inquiry.

The relevance of these findings lies in their ability to inform a more inclusive and impactful research agenda. By strategically promoting intersectional frameworks, elevating underrepresented voices, particularly from global and economically diverse contexts, and investing in the full educational pipeline, WIED can lead efforts that advance academic knowledge and drive meaningful institutional change. Moreover, enhancing the visibility and academic influence of WIED research through broader dissemination and alignment with global discourses will be key to expanding its reach.

This study matters because it helps chart a more straightforward path forward: one where equity in engineering education is addressed through interventions and through critically informed research that interrogates structures of power, identity, and access. The findings serve as both a mirror and a map, reflecting current patterns and guiding intentional action toward a more equitable future in STEM.

The study is limited by its focus on WIED proceedings from ASEE, excluding research published on other platforms or higher-impact journals [29], [30], which may reduce the representativeness of global trends. Additionally, due to the lack of specific guidelines, variability in the quality of abstracts complicates comprehensive analysis and comparisons across studies.

Acknowledgments

The authors gratefully acknowledge the leadership and financial support of the School of Engineering at the Universidad Andres Bello, Chile. We also thank the Educational Research and Academic Development Unit (UNIDA) for its mentorship and guidance in developing research skills for higher education faculty.

References

[1] WIED, “Women in Engineering: Alliance for Diversity, Equity, and Inclusion”, *Women in Engineering Division*, 2025. Available in: https://sites.asee.org/wied/

[2] K. Petersen, R. Feldt, S. Mujtaba, & M. Mattsson, “Systematic Mapping Studies in Software Engineering”, *BCS Learning & Development*, jun. 2008. doi: 10.14236/ewic/EASE2008.8. Available in: https://www.scienceopen.com/hosted-document?doi=10.14236/ewic/EASE2008.8

[3] Y. Kovaleva, J. Kasurinen, E. Kindsiko, y A. Happonen, “State-of-the-Art Review on Current Approaches to Female Inclusiveness in Software Engineering and Computer Science in Higher Education”, *IEEE Access*, vol. 12, pp. 1360-1373, 2024, doi: 10.1109/ACCESS.2023.3346767. Available in: https://ieeexplore.ieee.org/document/10373034/

[4] R. Kumar (2008). *Research methodology*. Nueva Delhi: APH Publishing Corporation.

[5] R. Hernández Sampieri, C. Fernández Collado, and P. Baptista Lucio, Metodología de la investigación, 6a ed. México, D.F.: McGraw-Hill Education, 2014.

[6] J. Wolfe, B. A. Powell, S. Schlisserman, y A. Kirshon, “Teamwork in Engineering Undergraduate Classes: What problems do students experience?”, in *2016 ASEE*

Annual Conference and Exposition, New Orleans, jun. 2016. doi: 10.18260/p.26069. Available in: https://peer.asee.org/26069

[7] F. Beroíza-Valenzuela y N. Salas-Guzmán, "STEM and gender gap: a systematic review in WoS, Scopus, and ERIC databases (2012–2022)", *Front. Educ.*, vol. 9, p. 1378640, may 2024, doi: 10.3389/feduc.2024.1378640. Available in: https://www.frontiersin.org/articles/10.3389/feduc.2024.1378640/full

[8] L. F. Coimbra, L. M. A., Nascimento, Y. O., de Lima, A. M. Santos, C. E., Barbosa, G., Xexéo, & J. M., de Souza, "Women's Journey in STEM Education in Brazil: A Rapid Review on Engineering and Computer Science", *IEEE Access*, vol. 12, pp. 112576-112593, 2024, doi: 10.1109/ACCESS.2024.3442879. Available in: https://ieeexplore.ieee.org/document/10634487/

[9] S. Ghai, R. Thériault, P. Forscher, Y. Shoda, M. Syed, A. Puthillam, H. Ch. Peng, D. Basnight-Brown, A. Majid, F. Azevedo & L. Singh , "A manifesto for a globally diverse, equitable, and inclusive open science", *Commun Psychol*, vol. 3, n.º 1, pp. 1-9, jan. 2025, doi: 10.1038/s44271-024-00179-1. Available in: https://www.nature.com/articles/s44271-024-00179-1.

[10] J. Clark, S. L. C., A. Des Jardins, C. M. Foreman, B. W. Gunnink, C. Plumb, and K. R. Stocker, "Peer Mentoring Program: Providing Early Intervention and Support to Improve Retention and Success of Women in Engineering, Computer Science, and Physics", in *2015 ASEE Annual Conference and Exposition Proceedings*, Seattle, Washington: ASEE Conferences, jun. 2015, p. 26.1218.1-26.1218.11. doi: 10.18260/p.24555. Available in: http://peer.asee.org/24555.

[11] L. Drankoff, S. Furterer, and E. Hart, "Undergraduate Women in Science and Engineering Mentoring Program to Enhance Gender Diversity Demonstrates Success During the COVID Pandemic", in *2021 ASEE Virtual Annual Conference Content Access Proceedings*, Virtual Conference: ASEE Conferences, jul. 2021, p. 37952. doi: 10.18260/1-2--37952. Available in: http://peer.asee.org/37952.

[12] F. Aveta, M. Rawlins, A. Ghanavati, G. Ma, P. Junsangsri, and A. Kamat, "Breaking Barriers: Empowering Girls in STEM with Hands-On Learning", in *2024 ASEE Annual Conference & Exposition Proceedings*, Portland, Oregon: ASEE Conferences, jun. 2024, p. 48405. doi: 10.18260/1-2--48405. Available in: http://peer.asee.org/48405.

[13] E. Blosser, "Constructions of Gender in Three Campaigns to Recruit Women to Engineering: Is Outreach Combatting or Reinforcing Gender Inequality?", in *2015 ASEE Annual Conference and Exposition Proceedings*, Seattle, Washington: ASEE Conferences, jun. 2015, p. 26.399.1-26.399.14. doi: 10.18260/p.23738. Available in: http://peer.asee.org/23738.

[14] C. Lam, S. Cruz, N. Kellam, and B. Coley, "Making Space for the Women: Exploring Female Engineering Student Narratives of Engagement in Makerspaces", in *2019 ASEE Annual Conference & Exposition Proceedings*, Tampa, Florida: ASEE Conferences, jun. 2019, p. 33078. doi: 10.18260/1-2--33078. Available in: http://peer.asee.org/33078.

[15] A. Morse, K. Millerick, K. Tindle, L. Cremeans, and S. Jones, "Lowman's 2D Model of Effective College Teaching: Justifying the Need for Faculty Diversity", in *2017 ASEE Annual Conference & Exposition Proceedings*, Columbus, Ohio: ASEE Conferences, jun. 2017, p. 28635. doi: 10.18260/1-2--28635. Available in: http://peer.asee.org/28635.

[16] B. Louie, J. Silverstein, and R. Sandekian, "Using Data to Mitigate Bias in Engineering Faculty Career Outcomes", in *2020 ASEE Virtual Annual Conference Content Access Proceedings*, Virtual On line: ASEE Conferences, jun. 2020, p. 35460. doi: 10.18260/1-2--35460. Available in: http://peer.asee.org/35460.

[17] C. L. McCullough, “Problem-based Learning as a Tool in Addressing Gender Bias”, in *2015 ASEE Annual Conference and Exposition Proceedings*, Seattle, Washington: ASEE Conferences, jun. 2015, p. 26.1255.1-26.1255.9. doi: 10.18260/p.24592. Available in: http://peer.asee.org/24592.

[18] O. Egbue, A. Khan, and R. Al-Hammoud, “Analysis of Workplace Climate for Female Faculty of Color in Computer Science and Engineering”, in *2019 ASEE Annual Conference & Exposition Proceedings*, Tampa, Florida: ASEE Conferences, jun. 2019, p. 32090. doi: 10.18260/1-2--32090. Available in: http://peer.asee.org/32090.

[19] D. Maynen, “Women Electrical Engineering Faculty: How do they Experience EE Department Climate and Promotion and Tenure” in *2021 ASEE Virtual Annual Conference Content Access Proceedings*, Virtual Conference: ASEE Conferences, jul. 2021, p. 38105. doi: 10.18260/1-2--38105. Available in: http://peer.asee.org/38105.

[20] J. Carpenter and D. P. O’Neal, “Developing and Implementing Effective Campus Work–Life Policies: The Story of One NSF ADVANCE Project”, in *2015 ASEE Annual Conference and Exposition Proceedings*, Seattle, Washington: ASEE Conferences, jun. 2015, p. 26.495.1-26.495.12. doi: 10.18260/p.23834. Available in: http://peer.asee.org/23834.

[21] D. Karpman, “Leaning into Engineering: Tenured Women Faculty and the Policies and Programs that Support Them”, in *2016 ASEE Annual Conference & Exposition Proceedings*, New Orleans, Louisiana: ASEE Conferences, jun. 2016, p. 25529. doi: 10.18260/p.25529. Available in: http://peer.asee.org/25529.

[22] M. Dabić, T. O. Posinković, J. F. Maley, B. Vlačić, G. Marzi, y S. Kraus, “Exploring the Multifaceted Challenges of Women in Engineering: A Comprehensive Literature Review”, *IEEE Trans. Eng. Manage.*, vol. 71, pp. 3325-3339, 2024, doi: 10.1109/TEM.2023.3342980. Available in: https://ieeexplore.ieee.org/document/10372121/.

[23] V. Kamalumpundi, K. Neikirkb , D. Kamin Mukaz, Z. Vue, N. Vue, S. Perales, and A. Hinton, “Diversity, equity, and inclusion in a polarized world: Navigating challenges and opportunities in STEMM”, *Mol Biol Cell*, vol. 35, no. 11, p. vo2, oct. 2024, doi: 10.1091/mbc.E24-06-0264. Available in: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11617101/.

[24] L. Salas-Morera, R. Ruiz-Bustos, M. A. Cejas-Molina, J. L. Olivares-Olmedilla, L. García-Hernández, y J. M. Palomo-Romero, “Understanding why women don’t choose engineering degrees”, *Int J Technol Des Educ*, vol. 31, no. 2, pp. 325-338, abr. 2021, doi: 10.1007/s10798-019-09550-4. Disponible en: http://link.springer.com/10.1007/s10798-019-09550-4

[25] A. M. French, N. M. Else-Quest, M. Asher, D. B. Thoman, J. L. Smith, J. S. Hyde, and J. M. Harackiewicz, “An Intersectional Application of Expectancy-Value Theory in an Undergraduate Chemistry Course”, *Psychology of Women Quarterly*, vol. 47, n.º 3, pp. 299-319, sep. 2023, doi: 10.1177/03616843231153390. Available in: https://journals.sagepub.com/doi/10.1177/03616843231153390.

[26] L. T. Ko, R. R. Kachchaf, M. Ong, y A. K. Hodari, “Narratives of the double bind: Intersectionality in life stories of women of color in physics, astrophysics and astronomy”, Philadelphia, PA, USA, 2013, pp. 222-225. doi: 10.1063/1.4789692. Available in: https://pubs.aip.org/aip/acp/article/1513/1/222-225/877186

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

[28] S. Täuber, “Women Academics’ Intersectional Experiences of Policy Ineffectiveness in the European Context”, *Front. Psychol.*, vol. 13, may 2022, doi: 10.3389/fpsyg.2022.810569. Available in: https://www.frontiersin.orghttps://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2022.810569/full.

[29] E. Campos, C. L. Garay-Rondero, P. Caratozzolo, A. Dominguez, and G. Zavala, “Women Retention in STEM Higher Education: Systematic Mapping of Gender Issues,” in Women in STEM in Higher Education, F. J. García-Peñalvo, A. García-Holgado, A. Dominguez, and J. Pascual, Eds., Singapore: Springer Nature Singapore, 2022, pp. 127–142. doi: 10.1007/978-981-19-1552-9_7. Available in: https://link.springer.com/chapter/10.1007/978-981-19-1552-9_7.

[30] S. Verdugo-Castro, A. García-Holgado, M. C. Sánchez-Gómez, A. Dominguez, I. Hernández-Armenta, F. J. García-Peñalvo, and A. Vázquez-Ingelmo, “Identificación de barreras y motivaciones percibidas por mujeres estudiantes de ingeniería y matemáticas: Estudio de caso en España y Latinoamérica,” in *Estudios interdisciplinares de género*, M. del Pozo Pérez and A. Rodríguez Sánchez, Eds., Thomson Reuters Aranzadi, Chapter 49, pp. 813–828, 2021.