

An examination of the gender gap among Middle Eastern students in Engineering: A systematized review

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Abstract:

This systematized literature review examines the persistent gender gap in engineering education among Middle Eastern students, focusing on the cultural, social, and institutional barriers that assist in the underrepresentation of women. Utilizing a systematic review process, we analyzed 33 peer-reviewed studies published between 2000 and 2024 to identify patterns and trends in gender disparities. Findings indicate how obstacles, including cultural norms, lack of role models for women, and institutional discrimination, prevent Middle Eastern women from participating and progressing. These results indicate the need for targeted policy interventions and educational reforms to promote gender equality and inclusiveness in engineering. Results also show the benefits that would be reaped by increasing women's participation in the engineering field. We discuss our process and findings further.

Keywords: gender gap, Middle Eastern students, engineering, systematized review

Introduction:

There is clear gender inequity in the global landscape of engineering education and professional practice, leading women to be significantly underrepresented in comparison to men [1]. These differences are especially clear in Middle Eastern countries, where such societies exist with special cultural, social, and institutional characteristics that lead women to face unique challenges. These features—for example, job market biases that favor males in engineering and other technical fields and societal expectations that steer women towards fields perceived as more “suitable” for them, such as medical and basic sciences—significantly increase the challenges and barriers that female engineering students face in Middle Eastern countries [2]. Understanding the specifics of these challenges in the Middle East is essential for developing policies and strategies that help promote gender equity, allowing more women to pursue engineering careers.

The complexity and persistence of these barriers are highlighted by the different rates of participation of women in scientific fields in different Middle Eastern countries, which are often influenced by economic and social factors. For example, El-Ouahi and Larivière [3] report that while Tunisia, Lebanon, Turkey, Algeria, and Egypt have relatively higher shares of women researchers, Saudi Arabia notably lags behind with significantly lower participation. Despite recent policy advances aimed at improving gender equality, these disparities persist, with women in the Middle East participating less in scientific research compared to their counterparts in regions like the United States, where women held about 28% of science and engineering positions in 2021 [4]. In some Middle Eastern countries, like Saudi Arabia, only 17% of women in this area work in the STEM sector [5]. This figure highlights the need for more effective implementation of policies to close the gender gap in scientific fields within the Middle East. No other statistics about other countries, or the Middle East broadly, are available. Understanding the roots of these inequities is essential for creating effective, targeted interventions to promote gender equality and improve diversity in engineering [6].

The gender gap is a crucial issue to address in engineering overall [7]. Despite the fact that the number of women and men in academic fields varies around the world, and women are often in the minority, this difference is much clearer in engineering fields [8]. This gender gap has become

one of the fundamental challenges, especially in Middle Eastern countries [9]. Despite advances to improve women's education, there are still problems such as gender discrimination, lack of proper representation of the role of women in society, and cultural and social barriers [10]. Therefore, it is important and necessary to study the issue of the gender gap and the factors affecting it [11].

Solving the gender gap is of interest to scientific education [12]. Despite the implementation of many policies to reduce the gender gap, the difference in the rate of women and men in the field of engineering, especially in Middle Eastern countries, remains significant. These differences can also have negative effects on scientific and technological progress [12]. The “credentials equilibrium” described by Salehi-Isfahani [13] refers to a system in which educational qualifications in the Middle East were primarily aimed at securing public sector jobs rather than fostering broader economic productivity. This factor has led to high youth unemployment and inefficient use of educational investments. It also provides a crucial backdrop for understanding the gender disparities in engineering education in the Middle East. Due to the developments in technology and the economy of the world, the need for engineers and specialists has also increased. However, women are much less present in such fields [14]. Due to various reasons such as gender discrimination, organizational culture, and social restrictions, women in some countries experience different obstacles, which have many negative effects on their presence in engineering [9].

Middle Eastern countries are among the regions where the gender gap in the field of engineering most clearly exists. In this region, more in some countries than others, culture and social traditions have led to differences in educational opportunities for women and men [15]. For example, despite high levels of urbanization and wealth from oil resources, countries like Saudi Arabia and Oman still show significant gender disparities in educational achievement and labor force participation in engineering fields. Unfortunately, in these regions, the trend for women entering engineering fields is always associated with many challenges and is often perceived as a cultural and social problem. Buse [16] emphasizes that the underrepresentation of women in engineering is not only a complex issue but also one that requires novel insights and innovative methodologies to address it effectively. The gender gap in engineering in these areas depends on many factors, the most important of which is gender discrimination. This gender discrimination appears in this discipline in various aspects, such as the misrepresentation of women's role in society, cultural and social restrictions, political and legal restrictions, and a lack of access to educational resources, facilities, suitable job opportunities for women in engineering fields, and role models [15].

Although measures have been taken to reduce the gender gap, one of the most important impacts in this regard is the creation of policies aimed at creating equal educational and career opportunities for women in engineering. In addition, programs such as raising awareness and studies on the existing gender gap, promoting women's roles in science and technology, and motivating them in the field of engineering are practical and effective measures to reduce this gap [8]. Therefore, it is necessary and vital to investigate and analyze the gender gap among female students in Middle Eastern countries in the field of engineering. By examining the factors affecting this gap and providing and implementing appropriate solutions, it is possible to create gender equity in the field of education and especially engineering in this region [17].

Purpose and Research Question

Addressing the gender gap in engineering disciplines within the Middle East is crucial for utilizing the full potential of the women in these societies in science and technology. Despite various efforts to promote gender equity, significant disparities persist, underscoring the need for a detailed examination of the underlying factors. This study seeks to delve into these issues by evaluating and analyzing the gender gap among Middle Eastern female students in engineering disciplines as present in pre-existing, peer-reviewed studies. A focused review of scientific studies in this area will provide a comprehensive critique of the current state of the gender gap, aiming to identify effective strategies for fostering greater inclusivity. The central research question of this study thus is: *What are the specific cultural, social, and educational barriers that contribute to the gender gap in engineering education among female students in the Middle East?*

Methods

This review follows established guidelines for conducting systematic literature reviews, including conducting comprehensive searches of reputable databases, applying pre-determined selection criteria, performing an extraction of data, and a determination and report of findings (Borrego et al., 2014). Our processes are described further.

Search Procedures and Search Strings

A search for information sources to study the gender gap among Middle Eastern female engineering students was conducted. Specifically, we used the database Education Source to search for articles. We used one database because this was a preliminary project. Based on our inclusion criteria, we sought to locate articles which were:

- Included college-age participants from a Middle Eastern country,
- Which discussed gendered differences.

Given our criteria, our final search string for this work was as follows:

('gender gap' OR 'female participation' OR 'women in engineering') AND
('Middle Eastern' OR 'Arab') AND ('engineering education' OR 'STEM fields').

We further parsed results down to the years 2000-2024 and limited literature to peer-reviewed journals written in English or Persian (the languages spoken by one or more authors).

Data Analysis Method

We conducted a detailed content analysis to explore the gender gap among female engineering students in the Middle East. We prepared an Excel file to manage the information efficiently, applying inclusion and exclusion criteria to organize the articles. Initially, we reviewed the abstracts of these articles, removing those that did not meet our criteria. Subsequently, we examined the full texts of the remaining articles, further refining our selection by discarding those that were not directly related to our study. Throughout this process, we carefully noted key themes and patterns, such as cultural influences and educational barriers, in our Excel file. This systematic approach allowed us to identify common challenges and trends, which we then summarized clearly, providing insights into the barriers and proposing potential solutions to reduce the gender gap in engineering education within the region.

Finalized Search Results

We found $n=124$ papers in our initial search. After screening for abstracts, we were left with $n=49$ papers. A total of $n=22$ papers were removed because they dealt with children instead of adults. Another $n=53$ articles were removed as they did not relate to women or engineering. The final $n=49$ papers were read full-text. Of the selection, another $n=16$ were removed that did not discuss the gender gap. A final $n=33$ papers were reviewed amongst our final review presented. This process is shown through the PRISMA diagram [18], represented in Figure 1.

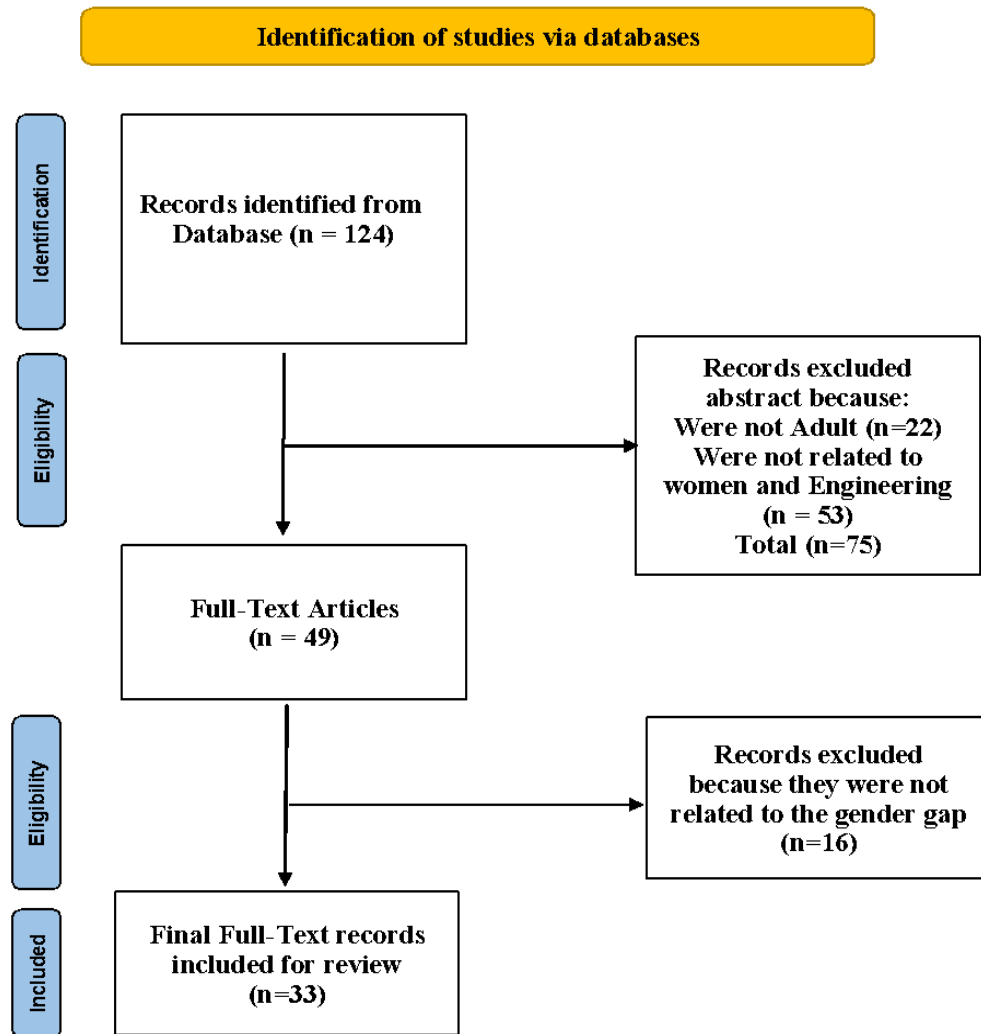


Figure 1. A PRISMA diagram showing our search process, including removal of articles.

Of the $n=33$ final studies, $n=20$ were quantitative, $n=8$ were qualitative, and $n=5$ were mixed-or multi-method. The Middle Eastern countries that are the focus of the articles in this literature review include the United Arab Emirates, Saudi Arabia, Turkey, Israel, Palestine (Gaza Strip), Qatar, Lebanon, Oman, Kuwait, and Iran.

Results

The findings of this systematized review highlight the complex nature of the gender gap among engineering students in the Middle East. Gender inequality in this area is affected by the interplay of cultural, social, institutional, and individual factors. This discussion will go into detail and make suggestions to address the gender gap.

Theme 1: Cultural and Social Factors

Our findings show the profound effects of cultural norms and social expectations on academic and career choices among Middle Eastern women. Particularly, social pressure is a very important and determining factor in their academic and professional paths and potentially impacts their participation in engineering fields. The roles and responsibilities that are traditionally held by women emphasize family responsibilities over professional job, especially in fields such as engineering that are considered masculine [19]. Forgasz et al. [20] emphasize that STEM fields, especially mathematics, science, and computing, are globally and locally perceived as male-dominated fields. This view likely discourages Middle Eastern women from continuing in these fields and leads to the continuation of their underrepresentation. Sabbah and Heyd-Metzuyanim [21] discuss the effects of ethnic and religious issues and gender inequality attitudes on the scientific identity of Arab female students in Israel. The authors show that by combining broad social issues with gendered and religious stereotypes, women's challenges in the STEM fields become far more complicated. Their study highlights the experiences of two students, Lena and Mira, at a predominantly Jewish Israeli engineering institution. While Mira faced ethnic and religious conflictual narratives, Lena dealt with gender-inferiority narratives, illustrating how these intersecting issues shape the academic identities and challenges of female Arab students.

Additionally, Sulaiman and AlMuftah [22] identified economic development and access to modern education as a crucial and influential factor in changing Qatari women's status and emphasized these factors' importance in cultural and social structures. They illuminate the impact of economic and educational reforms on changing traditional attitudes and increasing women's participation in engineering. Adely [23] discusses the broader implications of educational trends and gender biases and emphasizes that gender bias hypotheses may not hold true across different cultures, as seen in the Middle East. They emphasize that in applying gender equality strategies, positioning and consideration of specific cultural aspects should lead to more targeted and effective interventions in addressing the gender gap in engineering education. These findings highlight the broader societal and cultural factors that influence women's career paths in engineering in Middle Eastern countries. Findings further emphasize the complex dynamic of cultural, social, and economic factors that must be addressed to close the gender gap in engineering fields across the region.

Theme 2: Institutional Barriers

We also found that institutional barriers, such as gender discrimination and lack of supportive policies, exacerbate the gender gap in engineering. These barriers are seen in educational and professional environments, where not enough attention to local situations and women's specific needs makes it harder for women to enter STEM fields successfully. For instance, Aswad et al. [24] emphasize the inclusion of local contexts in policy with the aim of increasing women's participation in STEM fields. They suggest that regionally specific policies are necessary to address the unique cultural and institutional challenges women face in STEM. Taleb [25] highlights the potential of sustainable energy courses designed for women in Saudi Arabia. They

show that opportunities for educational design that is especially interesting for women and increase their participation in engineering fields. Naor et al. [26] evaluate the effects of ultra-Orthodox women's curricula in Israel and point to differences in motivation and career paths between ultra-Orthodox and secular students. They show the importance of considering each group's diverse and specific cultural and religious contexts in the design of educational programs, which can be solutions to fill the gender gap in engineering education.

Pasha-Zaidi and Afari [27] found the effects of gender disparities in the perceptions of STEM educators in widening the gap. They show how gender biases in the perception of confidence figures in education can influence female students' sense of belonging and efficacy in STEM fields. Machado-Taylor and Özkanli [28] demonstrate that gender disparities in career and educational advancement in Portugal and Turkey are significantly influenced by ongoing educational and professional stereotypes, which hinder the career development of women. They suggest that stereotyping is an inclusive institutional barrier that can prevent women from advancing in STEM careers. Elnaggar [29] emphasizes socio-cultural norms and limited access to education as barriers for women, by conducting a gender-sensitive assessment of the information and communication technology (ICT) space in Oman. They suggest that institutional constraints on providing equal educational opportunities can limit women's career advancement in technology fields and affect the broader engineering sector. The findings of this study show that women's participation and progress in these fields can be greatly improved through changing information and communication technology policies to better respond to their requirements.

Machado-Taylor and Özkanli [28] emphasize differences in academic career development between male and female academics. They indicate the importance of institutional support to remove these obstacles. Atakan et al. [30] highlight the ethical principles of future managers and show that female Turkish students adhere more to ethical principles in the workplace than males, which can influence their career choices and career advancement. This insight suggests that women's ethical concerns can be used to promote more equitable rules in engineering. Al-Sanad and Koushki [31] show the direct relationship between the feeling of equality with GPA, the field of specialization, and years of experience. They emphasize the importance of institutional support to help strengthen gender equality. They also show that organizational efforts to encourage a sense of equality can have tangible educational benefits, directly increasing and improving the academic performance and career prospects of women in engineering.

Theme 3: Lack of Role Models and Mentors

One of the most important obstacles to women's participation in engineering fields is the lack of female role models and mentors [32], [33]. This gap challenges female students' perception of themselves in these roles. Bamberger [34] explains the importance of visibility and mentorship from female role models in encouraging girls to pursue STEM careers. As more women participate in STEM, a positive feedback loop can develop, where their visibility further encourages new entrants. Ghazal Aswad et al. [35] clarify the need for actions to increase awareness of the STEM field and potential career paths to attract more women. Raising awareness can effectively change perceptions and increase women's participation, essential in reducing gendered inequalities. These elements of mentorship programs, coupled with increasing the visibility of successful women in engineering, may be important in changing perceptions and overcoming gendered inequalities that could contribute to increased enjoyment and retention within the profession.

Theme 4: Emotional and Psychological Factors

Emotional intelligence and psychological support are vital factors in the academic and professional success of female engineering students [36]. This finding highlights the need for institutional support systems to strengthen women's emotional resources, which is important to address the emotional barriers expressed in our research question. Sabbah and Heyd-Metzuyanim [21] discuss the emotional and psychological aspects and examine the identity stories of female students at a predominantly Jewish-Israeli engineering university. Understanding and examining these narratives helps reveal these students' personal and cultural challenges, directly related to our research on psychological barriers in engineering education. Labib et al. [37] found that personal satisfaction and family support effectively increase students' motivation to study engineering. These findings emphasize the importance of addressing emotional and psychological needs to strengthen academic and career success. Findings also reveal the direct relationship between emotional well-being and educational outcomes and reinforce our study's need to examine psychological support strategies. Makarem and Metcalfe [38] show that Lebanese women in the STEM field often face various microaggressions that affect their work experiences. These types of events can significantly hinder the advancement and retaining of women in STEM fields. Participants used flexible solutions to such problems and highlighted the need for organizational changes to support gender equality. In addition to showing their flexibility, these strategies emphasize the need for structural changes to create an equitable work environment for women, which is related to individual and institutional factors related to our research. By examining individual and structural factors such as emotional intelligence and psychological barriers, along with institutional supports and barriers, this section helps us to understand better the comprehensive nature of the challenges faced by female engineering students.

Discussion & Implications

Answering our Research Question

We investigated the following RQ: What are the specific cultural, social, and educational barriers that contribute to the gender gap in engineering education among female students in the Middle East? Our research has found several important themes that help us understand and tackle the challenges that Middle Eastern women face in engineering. These challenges are connected and come from cultural, social, institutional, and psychological factors that affect women's choices, opportunities, and experiences in engineering. To truly lessen the gender gap in engineering, our solutions must be well-rounded and sensitive to cultural differences. It is crucial that we do more than just offer basic access to education; we must also actively work against the common stereotypes and norms that keep women from entering engineering. Also, it is important to change institutional policies to be more welcoming and to change educational and professional settings to support women's needs better. This effort includes making policies that encourage women to join and stay in these programs from the beginning. Additionally, making female role models and mentors more visible can help encourage and guide women who want to become engineers. This change can greatly boost women's confidence and ability to succeed in a field that is mostly dominated by men. Lastly, we must focus on the emotional and psychological health of female students and professionals in engineering. Having support systems that help with these aspects can greatly improve women's involvement and success in their academic and professional lives. By looking at all these areas, our research helps us understand the complex reasons that shape the

identities of Middle Eastern women in engineering and lays the groundwork for creating policies and educational reforms that aim to make the engineering field more inclusive and fairer.

Policy Interventions

In addressing our research question, it is necessary to implement policies to promote gender equity in education and the workforce. The provision of scholarships, more flexible academic programs, and career advancement schemes can help create more equitable opportunities for women in engineering. Al-Sanad and Koushki [31] and Aswad et al. [24] discuss the importance of policy interventions in Qatar and the UAE. Mehran [39] highlights how institutional support and educational reforms help in closing the gender gap. Using these policy interventions on a wider scale, despite creating more fair opportunities for women, will effectively increase the quality and diversity of the engineering workforce. Implementing measures such as awarding scholarships, creating flexible programs and career promotion plans will encourage and support women to pursue and succeed. In addition to achievement, the impact of such actions contributes to broader economic growth and innovation, as a diverse workforce is recognized as a key driver of creativity and problem-solving.

Increasing Awareness and Education

It is necessary to raise awareness about the gender gap in engineering and the importance of diversity [40] in the STEM fields. Educational campaigns, workshops, and seminars can encourage more women to enter engineering fields by changing societal attitudes. Research found that higher education positively influences women's entrepreneurial purpose, emphasizing the importance of supportive educational environments [41].

Mentorship and Support Networks

Implementing programs to support and guide women in engineering can ensure their success. Mentorship from successful women in the field can increase girls' motivation, while peer support systems provide emotional and academic support. Universities and professional organizations should help create and maintain these networks [26], [42]. Gurel et al. [43] suggest that modifying engineering-related messages to highlight both people- and things-focused aspects would make these fields more attractive to women and could address their underrepresentation. Increasing awareness and educational initiatives can enhance women's participation in engineering by changing cultural perceptions and attitudes. By increasing efforts through targeted campaigns, workshops and seminars, a supportive educational environment will be created, which will create a more inclusive and diverse engineering workforce. Such initiatives can create a more equitable perspective in engineering in the long term, where women's participation and leadership are recognized.

Addressing Workplace Discrimination

Addressing gender discrimination in the workplace is another important way to create opportunities for female engineer development [44]. Realizing anti-discrimination laws, advancing an inclusive workplace culture, and teaching equitable practices to employees, amongst other tactics, are important steps. Fiset and Saffie-Robertson [45] examine how gender and support from academic supervisors affect the outcomes of academic discussions, emphasizing the role of supportive environments in enhancing negotiation success for women. Smith and Dengiz [46] emphasize the importance of creating supportive professional environments that address the

specific needs of female engineers, thus improving their career progression. Addressing workplace discrimination effectively can change engineering into a field where female professionals not only survive but thrive. Performing strong anti-discrimination laws, preparing an inclusive culture, and providing inclusive education are crucial steps toward achieving this goal. These changes will not only ensure fair and equal opportunities for women but will also enhance the engineering profession with diverse perspectives, leading to greater innovation and a more robust problem-solving environment. As a result, inclusive workplaces will improve better job satisfaction, higher keeping rates, and more successful career paths for female engineers in Middle Eastern countries.

Socioeconomic Influences

Socioeconomic factors play a significant role in women's participation in engineering. Ayalon and Mcdossi [47] show how the economic achievements of nonacademic parents influence their children's acceptance in higher education fields. Ghazal Aswad et al. [35] and Kuhail et al. [48] highlight the importance of accounting for socioeconomics when developing policies to participate in different divisions of society in STEM fields. Finally, Elnaggar [29] provides a gender-sensitive assessment of the ICT space in Oman, emphasizing the need for inclusive policies. The research highlights how socio-cultural norms, unequal access to training, and a lack of career counseling inhibit women's participation in ICT. These barriers are intertwined with broader socioeconomic factors, impacting women's ability to contribute to and benefit from a knowledge-based economy. This issue could be modulated by policies such as scholarship programs and financial assistance that might help women overcome these barriers. Further, they might enable women from different socio-economic backgrounds to engage in educational opportunities. These will result in increases to the number of women into engineering.

Gender Stereotypes and Social Norms

Forgasz et al. [20] and Ngambeki et al. [43] discuss how social beliefs and gender roles impact the perception of STEM fields. Studies by Sulaiman and AlMuftah [22] and Cavas et al. [49] also explore how these stereotypes affect career choices and motivations among students in the Middle East and Turkey. Adely [23] and Remennick [50] discuss the broader effects of educational trends and gender biases. Cavas et al. [49] also identified that many students decide on career options during their last grade level in high school or after graduation, influenced by their job interests and social expectations. Challenging and changing gender stereotypes and norms can significantly alter the landscape of engineering, making it more accessible and appealing. By addressing these deep-rooted beliefs through education reform, community engagement, and targeted media campaigns, we can shift perceptions and inspire a broader, more diverse range of students to pursue careers in STEM. Such initiatives will not only increase the participation of women in engineering and other STEM fields but also foster a more inclusive culture that values and encourages talent regardless of gender, ultimately leading to a more equitable and innovative professional environment.

Educational and Career Choices

Studies by Bucak and Kadirgan [51], Akgunduz [52], and Labib et al. [37] examine the factors influencing students' choices in engineering specializations. These studies show the importance of career services, family influence, and personal satisfaction in shaping professional choices. Goldfarb [53] explores the motivations behind professional choices among Israeli ultraorthodox women, providing insights into gender dynamics in education and career decisions. Mehran [39] used a women's empowerment framework [54] to analyze relationships between, equality,

education, and empowerment in Iran, highlighting how these factors influence female participation. Enhancing support systems in education, such as career services, and recognizing the influence of family and personal satisfaction can play a pivotal role in guiding students, especially women, toward engineering. By better understanding and addressing these factors, educational institutions can develop targeted strategies that encourage more women to choose and succeed in engineering careers. Such measures will not only diversify the engineering workforce but also empower women by aligning their educational and career paths with their personal goals and societal needs, thereby promoting gender equality and broader socio-economic development.

Identified Gaps in Literature

Geographic and Demographic Gaps

The review generally discusses Middle Eastern students but does not specify underrepresented regions or demographic groups. Future research should focus on less economically developed countries, such as Yemen, Syria, and Iran, as well as on rural areas and lower socioeconomic status groups like small towns and nomadic groups in those areas. Exploring these regions and demographics can provide a more detailed understanding of the barriers and opportunities faced by female engineers.

Methodological Gaps

Most reviewed studies used quantitative methods such as surveys and statistical analyses to explore the gender gap in engineering. Despite valuable insights from quantitative methods, it can be said that there is a gap in the use of qualitative methods. Qualitative methods provide opportunities to understand the specific experiences of female engineering students leading to deeper knowledge. Methods like in-depth interviews, ethnographic studies, and longitudinal case studies can reveal complex perspectives and personal narratives often overlooked in quantitative research. Also, mixed-method approaches that combine quantitative and qualitative data can offer a deeper and more comprehensive view. Future research should consider employing these methodologies to gain richer, more detailed insights into the gender gap in engineering by shifting towards a more balanced use of qualitative and mixed-methods research. Future studies can provide more details and actionable insights addressing the barriers and opportunities facing female engineering students in the Middle Eastern regions. This methodological expansion is essential for developing targeted, effective strategies to bridge the gender gap in engineering education and practice.

Theoretical Gaps

In understanding the existing gender gap in engineering education among Middle Eastern students, not enough studies have engaged theoretical bases. Often, studies have used general gender theories and have not used specific frameworks that can provide more accurate insights. For example, theories such as social role [55] and expectancy-value theory [56] have not been used in this context. Social role theory examines the influence of social roles and expectations on behavior [55] which could provide valuable insights on how cultural norms affect the career choices of female students. Additionally, expectancy-value theory examines people's choice motivation based on their expectations of success and the value they place on work [56]. This theory could be used to clarify the decision-making processes of female engineering students. Furthermore, incorporating the concept of Engineering Identity, which explores how individuals perceive themselves as engineers and are recognized as such by others, could provide a nuanced understanding of how identity formation influences female students' persistence and success in

engineering. Applying these methods and other theoretical frameworks can assist in a deeper understanding of the complex factors leading to the gender gap.

Conclusion and Future Work

The gender gap in engineering among Middle Eastern students is a complex and multifaceted issue that requires comprehensive and targeted involvement. By addressing cultural and social barriers, implementing supportive policies, increasing awareness, and establishing mentorship programs, it is possible to create a more inclusive and equitable engineering education landscape. Continued research and collaboration among stakeholders are important for supporting progress and achieving gender equality in engineering fields.

This work is a precursor to a graduate student's dissertation (Author 1), which is expected to identify the factors that influence the engineering identity of female Middle Eastern engineering students, especially those who are Iranian. In this project, the student aims to explore women's career and academic challenges as well as their process of engineering identity formation. This work is expected to offer recommendations for the creation of successful policies and programs to improve the conditions of Middle Eastern women. These policies can support their success in the engineering field.

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Appendix A
Final Papers

No	Author	Title	Purpose	Method	Findings
1	[19])	Gender-Based Teams: Perceptions of Team Satisfaction and Effectiveness among Engineering Students in the United Arab Emirates	The current study addresses the perceptions of team effectiveness and team satisfaction among students working in same-gender teams on two separate campuses of an engineering university in the United Arab Emirates (UAE).	The research team used a one way multivariate analysis of variance (MANOVA) to analyze responses to the two single-item measures of team satisfaction and team effectiveness.	The present study provides an exploratory analysis of team effectiveness and satisfaction in this unique sociocultural environment.
2	[36]	Impact of Emotional Intelligence on the Academic Performance and Employability of Female Engineering Students in Saudi Arabia.	The present study aims to investigate the impact of emotional intelligence (EI) on the academic performance and employability of female engineering students in Saudi Arabia	Data were collected through carefully structured two questionnaires	Findings clearly indicate a strong impact of EI on the academic performance as well as future employability of these students.
3	[25]	The potential for launching a postgraduate course on sustainable energy in Saudi Arabia.	As part of this work, a survey has been distributed to all of the female students of Al-Ola College in order to examine their potential acceptance of such a	For the purposes of this work, the main data collection methods used are questionnaires targeting undergraduate students at Al-Ola College.	As a result of this Empirical research, a set of practical ‘enablers’ has been proposed in order to change the status quo with regard to the poor prospects for SE education in Saudi Arabia.

			proposed course dedicated to SE.		
4	[20]	Public views on the gendering of mathematics and related careers: international comparisons.	This study investigates whether mathematics, science, and computing are still perceived as male-dominated fields. It aims to understand global and country-specific societal beliefs about gender roles in these disciplines.	The study utilized Facebook for participant recruitment, gathering responses from 784 individuals across 81 countries. It focused more intensively on responses from nine countries-Canada, China, Egypt, India, Israel, Singapore, UAE, UK, and Australia-each with at least 30 respondents.	The findings reveal that, although many respondents do not hold gender-stereotyped views, there is still a significant perception that mathematics, science, and computing are more suitable for males than for females among those who do approve gender stereotypes.
5	[21]	Integration of Arab Female Students at a Technological University—Narratives of Identity in Figured Worlds.	The study examines the academic identities of 13 female Arab students entering STEM fields at a predominantly Jewish Israeli engineering university, focusing on how ethnicity, gender, and perceived academic potential intersect and influence their experiences.	The study uses qualitative analysis, particularly focusing on the experiences of two students, Lena and Mira, to explore broader themes. It employs concepts like current and designated identities and the space of authorship within figured worlds to analyze how conflicting narratives affect these students' identities.	The findings illustrate that ethnic and religious conflicts, as well as gender-inferiority narratives, strongly influence the students' academic identities. While Mira allocated predominantly with ethnic and religious conflicts, Lena faced challenges related to gender stereotypes. These personal narratives intersect with broader societal beliefs, impacting the students' experiences and success in STEM fields.
6	[26]	Inclusion of Ultra-Orthodox Students in Higher	This study examines how far the establishment of an	The methodology utilizes interviews with administrators	The analysis of results showed differences between ultra-orthodox and secular students in

		Education: A Case Study about Women Seminary in the Engineering College of Jerusalem.	ultra-orthodox (Haredi) women-only curriculum and learning environment created for their needs, such as extra Biblical studies, fosters students' enrollment and achievement in STEM.	accompanied by a Google questionnaire surveying students in order to compare the secular Azrieli College of Engineering with its new ultra-orthodox branch, Tmura Seminary, which aims to promote the achievement by ultra-orthodox Jewish women of an engineering diploma so that they can find employment in the job market.	their motivation for study, sources of information about suitable education institutions, balancing work and family life priorities, financial need for scholarships, and career path, which is directed toward finding a job in the high-tech industry rather than continuing after graduation to pursue a Master-level degree.
7	[27]	Gender in STEM Education: An Exploratory Study of Student Perceptions of Math and Science Instructors in the United Arab Emirates.	The current study addresses student perceptions of math and science professors in the Middle East. Gender disparity in science, technology, engineering, and math (STEM) education continues to exist in higher education, with male professors holding a normal position.	Thus, students in the present study were given a photograph of a supposed male or female math/science instructor and asked to rate that instructor based on the visual information provided.	Findings revealed that there was a significant cross-gender effect on student perceptions of math and science instructors in the United Arab Emirates.
8	[28]	Gender and Academic Careers in Portuguese and Turkish Higher	This study explores the disparity in academic career development between male and female academics in	The research utilizes education statistics and comparative analysis across Portuguese and Turkish higher education	The study finds that despite an increase in female undergraduate enrollment, women's participation in academic roles has not increased proportionally. Women

		Education Institutions.	higher education institutions in Portugal and Turkey, particularly focusing on the fields of science, mathematics, and engineering. It aims to identify how gender influences career paths and the participation rates of women in academia.	institutions to examine the gender effects on academic career development and to pinpoint disparities in the career advancements of male and female academics.	are often transferred to disciplines stereotypically labeled as women's fields and remain underrepresented in engineering, physics, and other hard sciences, indicating ongoing educational and professional stereotyping that affects their career advancement.
9	[34]	Encouraging Girls into Science and Technology with Feminine Role Model: Does This Work?	This study assesses the impact of a program designed to inspire ninth-grade girls in Israel to pursue careers in STEM. The program included school visits to a high-tech company and interactions with female role model scientists.	The study involved 60 female students from a Jewish modern-orthodox single-sex secondary school, with 30 students participating in the program and 30 in the control group who did not. Data collection was conducted using pre-post questionnaires, observations, and focus group interviews, analyzing perceptions of scientists, capability in STEM, and future career interests.	The results showed increased respect for women scientists as smart and creative. However, there was a negative shift in perceptions towards women in science/engineering, their capabilities in STEM, and interest in STEM careers among the participants. The study discusses possible reasons for these outcomes and their educational implications.
10	[47]	Economic achievements of nonacademic parents and patterns of	This study investigates horizontal stratification in higher education in Israel, focusing on how economically	The research employs a multinomial logistic regression analysis of 8,036 Israeli first-year students in 2014,	The findings reveal that daughters of wealthy nonacademic parents uniquely prefer lucrative fields. Private colleges play a crucial role for academically

		enrollment in higher education of their children: the case of Israel.	established non-academic families influence their children's choice of lucrative fields and institutions, highlighting gender differences in these decisions.	examining the choice of institution and field of study based on their socioeconomic background.	disadvantaged children from these families, providing access to business and law studies. Women from these backgrounds are less likely to choose lucrative fields in public colleges, which are more STEM-oriented. High-credential children from these families opt for prestigious universities when pursuing lucrative fields.
11	[41]	Gender, risk-taking and entrepreneurial intentions: assessing the impact of higher education longitudinally	This longitudinal study assesses whether higher education has the same impact on the entrepreneurial intentions of women and men with regard to their tendency to risk-taking in particular.	The methodology of this study involved a longitudinal approach where data was collected through a self-administered survey. The survey targeted students studying business and engineering at five universities in Turkey. Data collection occurred at two distinct points: during the first and fourth years of the students' academic studies. A total of 215 students participated in both survey waves, allowing for a comparative analysis of changes over time.	The study's findings revealed significant gender differences in the impact of higher education on entrepreneurial intentions, particularly related to risk-taking propensity. Education had a more pronounced positive effect on women's entrepreneurial intentions, regardless of their risk-taking levels, with a notably greater impact on women with low risk-taking propensity. Conversely, the educational effect on men's entrepreneurial intentions was negative, affecting those with both high and low risk-taking propensity. These results suggest that higher education enhances women's likelihood of pursuing entrepreneurship more than it does for men, highlighting the

					need for tailored educational approaches in this area.
12	[43]	Using Profiles of Person—Thing Orientation to Examine the Underrepresentation of Women in Engineering in Three Cultural Contexts.	The purpose of the current research was to examine differential orientations to people and things among college students and their relations to academic majors and career choices across cultures.	To explore the effects of sex differences among these orientations and the relation to major and career choices, data were collected from 511 engineering and non-engineering university students in Greece, Turkey and the United States regarding their current and prospective majors, their intention to pursue careers in various fields, their confirmation of gender role, and their differential orientations to mastery of objects or interpersonal interaction.	The study found that "thing orientation" is a significant predictor of interest in engineering majors and careers across Greece, Turkey, and the United States. For engineering majors, thing orientation was a stronger predictor of interest for women than for men, indicating that women may require more focused motivation to pursue engineering careers that traditionally do not align with gender roles. The study suggests that modifying engineering-related messaging to highlight both people and thing-focused aspects could make the field more attractive to women, potentially addressing their underrepresentation. The predictive validity of the instrument used to measure these orientations was confirmed across different cultural contexts, emphasizing the importance of personal interests in academic and career choices.
13	[44]	The perception of women engineers in the construction	The purpose of the current study is to find out the working	The study examined the working conditions and career prospects of	The findings of the study highlight a significant issue of discrimination against women in

		industry in Palestine.	conditions of Palestinian women civil and architectural engineers in the construction industry in the Gaza Strip, Palestine.	Palestinian women civil and architectural engineers in the construction industry within the Gaza Strip. The research methodology involved collecting data through interviews, surveys, or observations (the exact method is not specified in the abstract). This approach aimed to gather in-depth insights into the experiences of these women throughout their academic and professional careers.	the construction industry, a field traditionally dominated by men. Despite women and men being equally capable when given the same opportunities, women in this sector face unique challenges and barriers. The study suggests that both men and women need to undergo attitudinal changes to minimize or cope with these challenges, indicating that shifting societal and professional perspectives is crucial for improving the conditions for women in this field.
14	[22]	A Qatari perspective on women in the engineering pipeline: an exploratory study.	This article aims to show the barriers to progress, tracking the performance and the emerging trend of success at the undergraduate level of women in engineering in a different cultural dimension.	Secondary research, particularly statistical data of female undergraduate engineering students at Qatar University (QU), is used in this study.	Findings show that the booming economic development and access to modern education are the key drivers that change the position of women in Qatari society.

15	[32]	Are women engineers in Lebanon prepared for the challenges of an engineering profession?	This study investigates the status of women engineers in the Middle East, considering women engineers in Lebanon as a case study.	An online survey consisting of Likert-scale items was completed by 327 female engineers who graduated from universities in Lebanon and now work in various locations around the world.	Although participants reported that they possessed enough theoretical knowledge and technical skills before graduation, in the actual practice of engineering, they noted weaknesses in creativity and innovation.
16	[24]	Creating a knowledge-based economy in the United Arab Emirates: realising the unfulfilled potential of women in the science, technology, and engineering fields	This paper examines the factors that influence women's decisions regarding their degree program and their attitudes toward science, technology, and engineering (STE).	The research utilized survey methods and semi-structured interviews to explore the factors influencing UAE women's decisions regarding their degree programs and their attitudes toward science, technology, and engineering (STE). This approach enabled the collection of both quantitative data from surveys and qualitative insights from interviews, providing a comprehensive view of the factors at play.	The study highlighted the need for policy adaptation to local contexts to enhance the participation of women in STE fields. It emphasized the impact of cultural and societal influences on women's career decisions and suggested increasing STE interest through awareness operations about the fields and potential career paths. The research also recommended addressing negative stereotypes about engineering, promoting family involvement in education, and expanding the availability of STE programs throughout the UAE.

17	[51])	Influence of gender in choosing a career amongst engineering fields: a survey study from Turkey.	The aim of this study is to understand the motivating factors behind students' choices in their decision-making process and also get an insight into their perception of different engineering branches.	This study employed a survey methodology to understand the factors influencing students' decisions regarding their choice of engineering specialization. The survey gathered 1163 responses, allowing for a strong analysis of preferences and influences on student decision-making in engineering disciplines.	The survey revealed that career services and family influence are significant factors in students' professional choices. Students prioritized job availability and personal satisfaction in their decisions. Notably, female students showed a distinct preference for Genetic and Bioengineering, Chemical Engineering, Environmental Engineering, and Industrial Engineering, while male students favored Mechanical, Civil, and Electronic Engineering. The results also demonstrated gender-based perceptions about the appropriateness of different engineering fields, influencing their choices.
18	[52]	A Research about the Placement of the Top Thousand Students in STEM Fields in Turkey between 2000 and 2014.	This research was carried out to investigate the STEM fields' placement of the top thousand students placed in science and mathematics fields in universities, the Student Selection and Placement Center (ÖSYM) university placement data as a basis.	This is a quantitative research and descriptive analysis techniques have been used.	There is a major difference between male and female students in favor of the males, that the students were placed mostly in engineering departments among STEM fields and that placement in education faculties and fundamental sciences was rather low.

19	[48]	Understanding Influencers of College Major Decision: The UAE Case.	This study aims to understand and analyze what influences female students to choose a college major in the United Arab Emirates (UAE)	The study utilized a survey approach targeting first-year female undergraduate students at Zayed University in the UAE, with a sample size of 496 participants. The survey aimed to identify personal, social, and financial factors that influence their choices of college majors. It also assessed the actions students undertook before deciding on their major, and the type of information they found most helpful for making such decisions.	STEM students are more influenced by business opportunities, prestige, and career advancement than others.
20	[49]	Turkish students' career choices in engineering: Experiences from Turkey.	This paper sets out to explore the issues that are relevant to understanding these gender differences and the factors affecting students' career choices.	The instrument called "Vilje-con-valg" was used to obtain data from 1635 first-year students from eight different departments- mechanical, civil, computer, electrical-electronics, industrial, chemical, environmental, and food engineering at 21 universities in Turkey.	The results of this study showed that (i) most of the students decided on career options during their last grade level in high school or after graduation from high school, (ii) students were influenced by the jobs that they were interested in;

21	[29]	Towards Gender Equal Access to ICT.	This research aims to provide a gender-sensitive assessment of the ICT space in Oman and the status of women within it, and to develop the seeds of an information base that provides gender analysis of the opportunities and challenges in the ICT space.	This study utilized a survey methodology to conduct a gender-sensitive assessment of the information and communication technology (ICT) sector in Oman, focusing specifically on the challenges and opportunities for women. The survey gathered data on various factors affecting women's participation and advancement in the ICT sector, such as socio-cultural norms, access to training, and career counseling.	The survey results highlighted several key barriers for Omani women in the ICT sector, including socio-cultural norms, perceived born character issues, limited access to training, and inadequate career counseling. These factors collectively contribute to women's marginalization in a traditionally male-dominated field. The study provides targeted recommendations for policymakers to reorient ICT policies to better accommodate the needs and aspirations of women in Oman, aiming to integrate them more effectively into the knowledge-based economy.
22	[31]	In Pursuit of Excellence and Gender Equality: Engineering Education at Kuwait University.	His pursuit of excellence in engineering education has earned the College ABET's "substantial equivalency" rating for six of its programs.	A comprehensive questionnaire survey of the alumni of the College of Engineering was performed.	The feeling of equality is positively and significantly correlated with GPA, field of specialization, and years of experience.
23	[39]	Doing and undoing gender'': female higher education in the	This study focuses on the triangle of education, equality, and empowerment, using Sara Longwe's	The study employed Sara Longwe's women's empowerment framework to analyze the interplay between education,	An important challenge is to understand why men are not entering different specialize and whether there is a possibility of "re-doing gender" – this time in

		Islamic republic of Iran.	women's empowerment framework to analyze the interplay between the three.	equality, and empowerment in the context of Iran's Islamic Republic, particularly during and after the 1980-1983 Cultural Revolution. This framework was used to assess the impact of state policies that aimed to Islamize universities and determine the "gender appropriateness" of each specialization, exploring how these policies influenced female participation in higher education	addressing male inequality and disempowerment at undergraduate levels.
24	[53]	Does God Want Me to Be a Teacher? Motives Behind Occupational Choice of Israeli Ultraorthodox Women	Motives behind the occupational choice of graduates in two tertiary training programs for Israeli ultraorthodox (Haredi) women, practical engineering (PE) and teaching (T), are explored.	Five hundred and twelve participants (278 PEs and 234 Ts) answered a questionnaire referring to 13 potential work motives.	The main findings are as follows: (a) factor analysis reveals that the 13 components group into the four composite factors of "intrinsic motive," "calling motive," "extrinsic motives relating to job conditions," and "extrinsic motives relating to the effect of choice on society"; (b) t-tests show that Pes express higher intrinsic motives than Ts and Ts express a higher sense of "calling" than Pes.
25	[23]	Decolonizing our questions/decolonizing our answers.	This article examines two educational trends and considers how neo-	The article employs a qualitative analysis to explore educational trends	The positioning of the West as the central frame of reference for understanding the "gender gap"

			colonial means of engaging with the region (particularly in the field of educational development) continue to limit the understanding of these trends and their significance in people's lives.	in the Arab world, focusing on the neo-colonial impacts on educational development. It discusses the growing male emergency in education, the increasing number of women in higher education, and the specific challenges and roles of women in the gendered discourse surrounding STEM education. The analysis is likely based on a review of existing literature, educational reports, and possibly interviews or surveys to gather insights into these trends	in STEM assumes that the gender biases in the United States surrounding math and science are universal when in fact there is much evidence to the reverse.
26	[50]	Career continuity among immigrant professionals: Russian engineers in Israel.	The study included a three-wave survey and three focus groups with immigrant engineers.	Five hundred students of the special Hebrew courses for engineers were recruited in 1992–93 (soon after their arrival in Israel) and then contacted again in 1997 and 2001.	The results show that, in all age and specialty groups, male engineers were much more likely to find engineering posts than female ones; younger engineers (below age 45) were more successful than older ones; specialists in electronics, computing, and high technologies reported better adjustment than engineers trained in more traditional fields (metallurgy, mechanics, etc.).

27	[35]	Assessing the impact of socio-economic inequities on college enrolment: emerging differences in the United Arab Emirates	This paper studies how socioeconomic status affects female students' enrolment in science, engineering, and technology fields. Using surveys and semi-structured interviews, we find that motivations for entering science, engineering, and technology fields differ such that women of higher socio-economic backgrounds have greater interest in studying non-science, engineering, and technology fields.	This study utilizes surveys and semi-structured interviews to examine the socio-economic factors influencing UAE female students' enrollment in science, engineering, and technology (SET) fields.	It is important that variations in socio-economic status be accounted for when devising policy recommendations to successfully integrate different segments of society into science, engineering, and technology fields.
28	[30]	An Empirical Investigation of the Ethical Perceptions of Future Managers with a Special Emphasis on Gender – Turkish Case.	This study presents an empirical investigation of the ethical perceptions of future managers – Turkish university students majoring in the Business Administration and Industrial Engineering departments of selected public and private Turkish universities – with a special emphasis on gender.	The perceptions of the university students affecting to the business world, the behaviors of employees and the factors leading to unethical behavior are analyzed.	The statistically significant differences reveal that female students have more ethical perceptions about the Turkish business climate, the behavior of employees, and the ethics of the behavior of the employees in comparison with their male counterparts.

29	[37]	What Motivates Students to Study Engineering?	In this research, the motivation to study engineering is studied and compared between male and female students in the College of Engineering at Prince Sultan University, the first private university in Saudi Arabia.	The study was conducted through a detailed survey distributed to 41 male engineering management students and 45 female architectural engineering students.	This role should be enhanced and utilized to encourage more female students to consider engineering majors in their college studies.
30	[45]	The Impact of Gender and Perceived Academic supervisory Support on New Faculty Negotiation Success.	The study aims to examine the effects of gender and perceived academic supervisor support (PASS) on the negotiation outcomes of newly chosen assistant professors at internationally credited business schools, focusing on how these factors influence the success of negotiations related to academic appointments.	The research utilized a sample of recently selected assistant professors from management faculties, employing quantitative methods to analyze the impact of gender and the support of academic supervisors on the outcomes of contract negotiations.	The study found that women were less likely to engage in negotiations and were generally less effective than men in negotiating elements related to direct advantage, such as salary and research funding. Additionally, it was observed that supportive academic supervisors significantly improved negotiation effectiveness for women, but had minimal impact on men's negotiation outcomes. The findings suggest that enhancing supervisor support in doctoral programs could help moderate some of the disparities in negotiation success between genders.
31	[33]	Life in the Fast Lane: Arab Women in Science and Technology.	This article aims to explore and challenge the common stereotypes of Middle Eastern	The study is based on qualitative methods, specifically conversations with young Arab women	The findings reveal that despite common Western stereotypes, Arab women are actively engaged and successful in STEM sectors.

			women in Western media, particularly those showing them as victims needing save. It focuses on the professional experiences of expatriate Arab women in the STEM fields within the high-tech start-ups and scientific enterprises across the United Arab Emirates and other Middle Eastern countries.	from various Middle Eastern countries working in STEM fields. These discussions address their experiences in the workplace, citizenship issues, family responsibilities, and the impact of societal expectations on their professional lives.	They face unique challenges related to cultural and familial expectations, workplace norms, and sometimes discriminatory practices based on gender and race. The article highlights the resilience of these women and their navigation through both professional and personal landscapes in their respective fields.
32	[38]	Microaggressions as a Framework for Understanding Women's STEM Career Experiences in Lebanon.	This study investigates the experiences of women working in STEM fields in Lebanon, focusing on their encounters with gendered microaggressions at work and the strategies they employ to navigate these challenges. It aims to extend the understanding of gender dynamics within STEM professions in Lebanon and offer insights for human resource management and career counseling.	The research utilizes qualitative data from interviews with 21 women in various STEM fields in Lebanon. It applies the subcategories of gendered microaggressions developed by Nadal (2010) to analyze the specific types of microaggressions micro-assaults, microinsults, and microinvalidations encountered by these women.	The findings reveal that women in Lebanese STEM fields frequently face diverse forms of microaggressions that affect their work experiences. To cope with these challenges, the participants employed four main tactics, which are detailed in the study. These adaptive strategies underscore the resilience of these women and highlight the need for organizational changes to support gender equity in the workplace.

33	[46]	Women in Engineering in Turkey – a large-scale quantitative and qualitative examination.	This study investigates the evolving presence of women in engineering within Turkey, examining how societal and educational dynamics have shifted over the past 76 years since the founding of the Turkish Republic, leading to a significant increase in female participation in engineering fields.	The research employed both surveys and facilitated focus groups involving over 800 participants to gather data on the perspectives and experiences of women in engineering in Turkey. This approach allowed for a comprehensive analysis of both quantitative and qualitative aspects.	Women in Turkey are attracted to engineering due to their passion for math and science, despite recognizing fewer opportunities and a shortage of role models compared to men. They also often find themselves in supportive roles professionally but continue to support their career choice in engineering positive.
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