

# Female Participation in Engineering Fields: Successes, Challenges, and Recommendations in a Non-western Context

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**Abstract.** This paper describes a collaborative faculty-student research project examining female students' perspectives on their academic and social experiences studying engineering at an American branch campus in Qatar. It draws on data collected from a series of focus groups, an anonymous survey, and self-reflexive research team meetings. The experiences are discussed in relation to the university's institutional strengths and challenges in terms of supporting female students for working in engineering-related careers in the Arab Gulf and recommendations are given.

**Keywords:** Women in engineering · Women in STEM  
Female engineering students · Women in the Arab Gulf  
Education in the Arab Gulf

## 1 Introduction

Research on female participation in Science, Technology, Engineering and Mathematics (STEM) fields has been conducted almost exclusively within Western contexts. Shifting our focus towards under-researched geographical and cultural settings can help create more nuanced analyses of the presence and role of women in various environments. It is in this context that the Arab Gulf, a region undergoing tremendous socio-economic transformations, may contribute to the body of research focusing on the role of women in the Middle East, specifically in regards to fostering female participation in fields that have been traditionally dominated by men.

For UNESCO, “science and engineering hold important answers to key questions like climate change and sustainable development that we must address today [...] especially in the developing world, where attracting more women to fields in which they are underrepresented must be a part of the solution” (UNESCO 2013). Despite the agency's call in the framework of the Millennium Development Goals, there are still numerous recurring challenges worldwide that relate to the participation of women in STEM. Some of the existing literature point toward the lack of role models, stereotypes and gender bias, workplace bias, and underrepresentation in leadership positions, as important challenges that negatively affect the advancement of women in STEM industries (Hill et al. 2010; McCullough 2011; Williams 2015).

Within university contexts, underrepresentation among faculty, and discrimination against female faculty and students, have been identified as pressing challenges (Hopkins 1999; Robnett 2015; Sheltzer and Smith 2014). Furthermore, Moss-Racusin et al. (2012) explain that both female and male faculty members have been identified to exhibit gender bias. Their article explains that faculty often evaluate female undergraduate students lower than their male counterparts—pointing toward negative perceptions of women that contribute to little support and mentorship. In a similar research, Moss-Racusin et al. (2015), argue that this bias, although frequently unintentional or implicit, has become a major challenge that relates to widespread socio-cultural stereotypes. Gender bias in the university is thus associated with the development of diversity interventions and prejudice recognition and reduction.

While the percentage of female students within STEM fields in the Middle East is comparable to, and in occasions higher than in Western countries (UNESCO 2013), the status of women studying STEM fields has only been marginally researched. Engineering enjoys a particularly high social status in the region attracting female and male students alike (Baytiyeh 2013; Iversen 2016). In two studies based in Lebanon and the UAE (Aswad et al. 2011; Baytiyeh 2013), the authors explain that the potential for professional growth and interest in the field are the principal motivating factors encouraging their participants' decisions to pursue engineering as their studies.

The Arab Gulf region, in this context, distinguishes itself by having a higher enrollment in STEM among female than male students (al-Wazir, 2016). For instance, 60% of engineering university students are female, double the percentages in the U.S.A. and Europe (Durrani 2015). Texas A&M University at Qatar (TAMUQ), our specific context, became the second university in Qatar to offer degrees in engineering in 2003. Currently, approximately 41% of the entire student body is female and within certain engineering majors, the percentage of females is 60%. The high rates of enrollment among women are unfortunately not consistent with those of women entering the workforce after graduation. In the Middle Eastern context, only 1 in 5 women graduating with STEM degrees, is employed in their field. (Mannan 2016). When writing of this issue, Kantor (2016) asks: "if young college graduates in the Middle East and North Africa are being told they should not or cannot pursue a career in their field, how can we expect to see stronger representation of women in STEM?" This question becomes particularly relevant when looking at the relationship between the participation of women in the workforce, particularly in relation to STEM, and economic competitiveness and productivity (Fawwaz 2014).

Concomitantly, some research pertaining to the Arab Gulf has focused on the relationship between individuals and the economy, and society and culture. Aswad et al. (2011) argue, in the context of raising awareness and overcoming negative stereotypes about STEM, for the adaptation of policies to diverse local contexts. Employment expectations, support systems, and family connections, moreover, contribute to women's education and career path (Fawwaz 2014). Previous government efforts in the Gulf region include a 2015 UAE Government Summit promoting the role of women in STEM, and the creation of a UAE Gender Balance Council with a series of collaborations with the Women in Engineering Committee (Margheri 2016). The Women in Engineering Forum of the Gulf Cooperation Council (GCC) was held in Qatar in 2013.

Despite some positive developments, stereotyping, cultural norms, and working in male-dominated industries are still pressing challenges for female engineering students entering the job market. Aswad et al. (2011) have argued that national culture and traditions can be discouraging for women pursuing engineering degrees. Furthermore, various authors have focused on examining deterring aspects for women's participation in STEM. Qayyum (2012) argues that socio-psychological barriers prevent female engineers from putting their skills into action in the context of their STEM careers. Baytiyeh (2013) has argued that partly because of lack of self-confidence stemming from being within traditionally male-dominated fields, women in engineering fields are not sufficiently prepared to transform knowledge into product. Similarly, other authors have looked at sociocultural constraints (Durrani 2015); women leaving the field to raise a family (Kantor 2016; Mitchell et al. 2015); and exclusion, discrimination, and restrictions (Iversen 2016).

Sulaiman and AlMuftah (2015) explain, based on data from Qatar's public university, that despite having high retention rates among female engineering students, the university should still attract more female students to their engineering degrees. Notwithstanding socio-cultural obstacles, they argue, women in Qatar have shown to be better educated than men. In the context of access to education and economic development, the position of Qatari women is changing, with more and more entering the professional world, even within traditionally male-dominated industries.

Some broad recommendations to improve the status of women working in STEM fields include the implementation of gender quotas within nationalization policies and equalizing salary benefits (Mitchell et al. 2015). Particular recommendations for universities have focused on developing leadership and management trainings (Baytiyeh 2013); attracting mentors and role models (Kantor 2016); focusing on more positive peer connections (Robnett 2015); fostering social-psychological interventions (Nnachi and Okpube 2015); and developing career services, internship opportunities, and connections with alumni (Fawwaz 2014). All steps that can be taken to promote and ensure gender equality within STEM are nevertheless contingent on addressing restrictive socio-cultural barriers that negatively affect the experiences of female engineering students in Qatar and beyond.

It is within this context, that this paper sheds light on a self-reflexive project to investigate the experiences of being female and an engineering student in Qatar and the successes and challenges at an institutional level, as well as offers recommendations.

## 2 Project

During the spring of 2016, the Women's Faculty Forum (WFF) at TAMUQ hosted a panel discussion on campus about "real-life strategies for overcoming struggles as females in industry, business, and academia." The feedback from TAMUQ female students who attended was overwhelmingly positive, with many indicating how encouraging and inspiring it was for them to interact with alumnae working in high-level positions in their fields. It was clear from informal discussions with students that they face

challenges as female engineering students and many desire more support and mentorship on how to overcome things like gender bias and fulfill their ambitions.

Considering this and in the context of high-impact educational practices, an engineering colleague and I proposed a collaborative faculty-student research project to develop and present recommendations on how to better support, encourage, and prepare our female students, especially our Qatari population, for working in engineering-related careers. As part of this project, we helped guide a small group of TAMUQ female students to have discussions on relevant literature, conduct focus groups, and develop and analyze an online survey to be completed by all female TAMUQ students. In addition, a survey to be completed by TAMUQ alumnae working in industry or academia is in progress.

In order to examine current student perspectives on the successes and challenges of being a TAMUQ female engineering student, the first part of our data collection included a series of focus groups with 6–8 current female students participating in each session. The questions revolved around why our students chose engineering and whether they are still satisfied with their choice, TAMUQ institutional strengths and weaknesses in terms of supporting our female students, experiences with professors and peers, and perceptions about challenges women face from society and industry in Qatar. The focus groups were transcribed verbatim and our student researchers helped to code the data and look for themes that seemed significant to the participants. Based on the findings of the focus groups, we worked with the students to design an anonymous survey to be sent to current TAMUQ female students. 100 responses were recorded out of the 231 female engineering students, which resulted in a 43.29% response rate. The majority of the students who responded were Qatari (57%). The students oversaw distributing and analyzing the survey responses and triangulating it with the focus group data.

The ultimate goal of the project was to explore TAMUQ's institutional strengths and challenges in terms of supporting our female students. After collecting and analyzing our data, our students came up with recommendations to help support, mentor, advocate for, and prepare our female students for greater long-term success in engineering careers.

By participating in this project, students engaged in many essential outcomes of high-impact educational practices. Students built their intellectual and inquiry skills by learning to ask relevant questions and develop social science research skills. At the same time, they conducted research and shared the results with their communities, which they then integrated and applied into a conference presentation and publication. This project also implemented some of the principles of A Whole New Engineer (Goldberg and Somerville 2014) in terms of making female students stakeholders in their own learning and having them contribute to developing recommendations for transformative educational experiences at TAMUQ.

### 3 Findings

In this section, we provide a brief overview of the findings of the focus group data (see Hillman et al. 2017, for a more thorough discussion of the focus group and survey data findings).

### 3.1 Why Our Students Chose Engineering?

In terms of why our students chose to study engineering, there were two main themes. Many mentioned a “passion” for fields such as mathematics or chemistry since an early age. Participants also discussed feeling the need “to prove” or “to show” something. Additionally, most of the participants’ families expressed preference towards their daughters studying in fields other than engineering, particularly when it came to petroleum engineering. Their family members worried that as females, the participants would not be able to get jobs when they graduated and would thus, waste their education, or would be around only men in the field. Despite participants’ families not being overly enthusiastic about their choice to study engineering, the participants all felt that their families were supportive of their decision in the end, but may still strongly guide their future career decisions.

### 3.2 Successes at TAMUQ

When we asked participants what they thought TAMUQ was doing well as an institution to support and encourage its female students, the number one thing that participants mentioned was that females outnumbered males at the institution. Having so many female peers provides support and encourages participants. They also discussed how they felt most of their professors are balanced in terms of encouraging both male and female participation in class, and that they have a chapter of the Society of Women Engineers (SWE) at TAMUQ.

### 3.3 Challenges at TAMUQ

Although participants expressed high satisfaction with their overall experience at TAMUQ and did not regret their choice to study engineering, they brought up multiple institutional challenges including:

1. lack of physical spaces where [Qatari] females can feel comfortable
2. gender bias from both professors and male peers
3. fewer research opportunities and trainings for females
4. not enough interaction with alumnae
5. lack of participation and an agenda promoting advocacy of female students in the Society of Women Engineers organization

### 3.4 Cultural/Industry Challenges

Beyond just the setting of TAMUQ, the participants discussed many perceived cultural, societal, and industrial challenges that female engineers face in Qatar and the wider Gulf region. These included:

1. Companies not accepting female employees
2. Companies not sponsoring females to study engineering

3. Gender bias and disparity in the workplace
4. Cultural expectations about women

## 4 Discussion

Findings from the focus groups and surveys revealed numerous factors affecting female engineering students at TAMUQ. From the moment the participants chose to study engineering, they faced various socio-cultural constraints related to choosing a male-dominated field. Students indicated interest in the field and a need to “prove” something to their families as motivating factors behind their decision.

Due to the university’s demographics of almost 60% female students, it is important to understand some of the institutional strengths and weaknesses in terms of supporting female students. When asked about institutional successes in terms of the university supporting its female students, there were some positive views towards professors and students were overall satisfied with the university and their choice of studies. The primary success, however, seems to be the enrollment of a large number of female students contributing to an unofficial support system through female peers. In terms of challenges, participants indicated the lack of a women-only physical space and with that lost opportunities for networking, gender bias from both professors and male peers, less research opportunities and trainings for females, lack of support and mentorship, particularly in terms of female role models and interaction with alumnae, and the lack of participation and advocacy for women in the Society of Women Engineers as the main aspects affecting them within TAMUQ. These institutional challenges are compounded by industry-wide practices in Qatar that are detrimental for women engineers. Participants, in this respect, indicated perceptions of companies not accepting female employees and not sponsoring females to study engineering, a prevalence of gender bias and disparity, and cultural expectations affecting women in the workplace.

The fact that participants’ perceptions indicate considerably more challenges than successes can be examined in light of a prevailing culture of gender bias and sexism towards women. Similar to findings reported in Alhasani (2013), Aswad et al. (2011) and Fawwaz (2014), it is possible to see mentorship and support systems, cultural norms, and stereotyping as crucial factors affecting women engineers in the region. Internally, TAMUQ needs to ensure consistency and fairness across genders, in terms of the space, support, and opportunities it provides to its students. It needs to better prepare its female students to navigate those ‘invisible barriers’ (Qayyum, 2012) and have strategies to assert themselves in male-dominated work settings. At the same time, industry-wide challenges need to be addressed to ensure women can use the skills they have gained from their engineering degree. It is in this context that we want to provide a series of recommendations based on the experiences of our participants.

In both the focus groups and in meetings with our faculty-student research team, a number of recommendations were suggested. These included:

- Creating opportunities for more interaction, including informal conversations, with alumnae

- Offering workplace skill development for current female students and continuing education courses for professional female engineers/alumnae on topics such as bias, negotiation, etc.
- Inviting more women working in industry to give lectures and workshops – organizing a special lecture series focused on women in STEM
- Hiring more female professors so that students have more role models
- Liaising with industry to encourage equal sponsorship opportunities and more equal hiring and retention practices
- Encouraging greater participation in the Society of Women Engineers and conducting activities that go beyond just social events to advocate for women and promote awareness of challenges facing women in STEM fields
- Providing more opportunities for students to discuss gender bias
- Designating space for a women-only lounge with desks and sofas that encourage female students to feel comfortable staying on campus, and to have an opportunity to network, to collaborate, and complete school work
- Providing funding for faculty and students to conduct further research on issues facing women in engineering in Qatar (such as this present study) and develop viable solutions

## 5 Conclusion

Although this study is limited in scope, it helps shed light on challenges faced by female engineering students in a non-Western context, such as the perceived detrimental consequences of not having segregated space or particular attitudes about gender roles and marriage in Qatar. It also supports findings from previous studies about challenges that women in STEM face worldwide, such as stereotypes, gender bias, and lack of role models. We hope to conduct further research on the experiences of TAMUQ alumnae. We also hope to conduct research on a wider scale with more engineering programs in Qatar and across the region.

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