



Empowering Women in Engineering

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Women and Engineering in Qatar

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Introduction

Engineering is a STEM subject (Science, Technology, Engineering and Mathematics) offering to young students the equipment, skills and knowledge to evaluate evidence, make sense of information and solve problems [1]. Therefore the ability to solve problems creatively has been identified as one of the imperative competencies for graduating students. The need to engage more female students to study STEM subjects is a worldwide concern and was also highlighted by US President Barak Obama [2]. By providing knowledge platforms, regardless gender differentiations, helps scientific society to broadness its achievements and consequently improve the industry outcomes. Gender discriminations in educational and occupational field though, have always been under question and investigation. This paper is an attempt to present efforts, motives and incentives that help Qatari female students to excel in their overall engineering studies and career through promoting participation in events, conferences and external competitions.

Educating and Inspiring Female Engineers

Primary education and school policies targeting in promoting females' interest in engineering followed by further innovative university education will assist future Qatari female engineering students to reveal and apply more qualification and abilities. US Department of Education, stated that during 1990-2005 in the USA there has been a continuous improvement at the high school girls' average grade point average (GPA) in math and science, lessons that are preparatory and basic for obtaining a future bachelor's degree in engineering [3]. Hill et. al (2010) stated that girls are benefited in math and science, due to a bigger mentality development, in a USA report [4] was stated that in K-12 girls take as many as high level mathematics and science courses like same aged boys, and in Australia there has been a substantial increase to female students, with high grades in math and science subjects (Gill et al. 2008). Hacker (1981) described the role of math performance as a 'critical filter' in succeeding in engineering. Robinson and McIlwee (1991) confirmed women's superiority in math performance and (Jagacinski and LeBold 1981) argued that females can demonstrate equal technical proficiency as men, preventing stereotypes and misconceptions regarding women [5]. Figure 1 describes the GPA of male and female high school graduates in math and science, for a period of 15 years, in USA; Figure 2, the number of women being awarded engineering degrees, proving that engineering is not a sex segregated field of work nor a male orientated field of education (Youn and Choi 2015). Highlighting STEM women's devotion to their careers, their mathematical abilities can be beneficial to their advanced confidence (Oh and Lewis 2011). Regarding professional performance, (McIlwee and Robinson 1992) stated that both genders display equal desires and wishes when it comes to get involved in strategic projects, applying practical contribution and obtaining administrative knowledge.

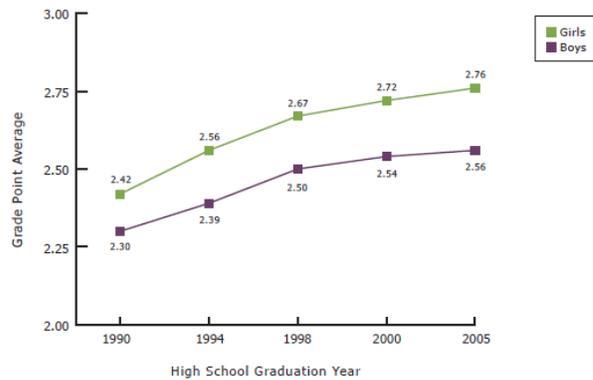


Figure 1. GPA in Math-Science [6]

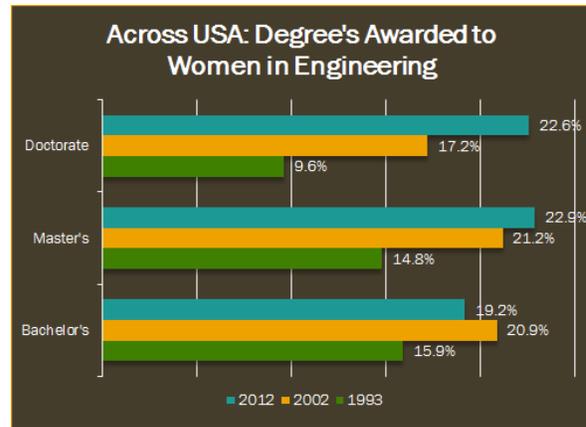


Figure 2. Women awards in Engineering [7]

The importance of family and working environment was also examined; engineers' family and friend background is more supportive than men's, whereas men are considered to find obstacles mainly from family (Inda, Rodríguez, and Peña 2013). Lent et al. (2005) confirmed that females receive more support and less barriers than male. Women can be identified as more systematic, better at listening and taking notes and more selfless (Stonyer 2002). In India (Escueta, Saxena, and Aggarwal 2013), reported, females' advanced confidence, respect and motivation is useful in all kind of working fields; specially women undergraduate engineers are more confident when compared with males of other discipline groups. Khazanee (1996) referred to female engineers, such as less aggressive attitude towards colleagues than males, tendency of listening more and acting not spontaneously, and being more attentive, accurate, and organized. Additionally, successful ability writing in math and science by females, can prove advantageous in all academic fields (Halpern et al. 2007), while introduction of unique and important perspectives and priorities will conclude into positive social outcomes and greater ethical accountability (Eagly and Carli 2003). Females are characterized as high self-confident regarding keeping up with the company's values and ethics, dealing with multiple roles and generally accomplishing different tasks (multirole behavior), can result into less friction experiences in both work and non-work obligations. The importance of promoting more women into leadership (Hoyt and Murphy 2016) and engineering roles is greater than just fulfilling the promise of equal opportunity and making businesses, institutions, and governments more representative. Other assets, include advanced self confidence in processing tasks, in navigating organizational culture/climate and enhanced ability to manage multiple life roles. Finally, academically oriented women are characterized by broad interests, emotional sensitiveness and tolerance of intellectual creativity (McIlwee and Robinson 1992), aspects that assist for a successful engineering career.

As a result, an overall advanced education system, enhanced with chances of participation in conferences and contests can prove to be well suited for females, for enhancing institutional productivity and boosting future engineering practices through articular skills, efficiencies and efficacies. Actions may include R&D tasks in science, math and engineering classes, among Qatari women and girls at all levels, by government, educational, corporate and professional engineering institutions groups. Qatar's current boosting in construction and infrastructure is a valuable asset for motivating females in following engineering paths.

Making the Difference by Changing the Culture

Members of the IEEE and the IEEE Women in Engineering (WIE) have launched a three stage project towards encouraging females for following engineering professions. In the first stage, females should be getting familiar with engineering and scientific achievements from an early age and in high frequency. Secondly, advanced recruitment programs emphasizing on electrical and mechanical engineering careers before enrolment in undergraduate majors can assist females of following such paths and break down of the social barriers.

In Rochester Institute of Technology [8], there is an organized girl engineers' camp where school girls participate in communities and events getting more familiar with STEM field. Women in Engineering Society [9], declared the 23rd of June as the "National Women in Engineering Day" for raising awareness and marking female engineering accomplishments and STEMNET has created the "STEM Ambassador" [10] role. The University of New South Wales (UNSW) [11] organizes specially designed for girls visits events (workshops on campus and camps) and scholarships to women applicants. Washington State University [12], has its own Society of Women Engineers Officers (SWE) that organizes "Kids Engineering Day" for local elementary schools. Other international organizations that promote female engineers are Society of Women Engineers [13], Women's Engineering Society [9], National Girls Collaborative Project [14], and IEEE Women in Engineering (WIE) [15] including IEEE for girls, Engineer Girl, Women of NASA Projects and Nerd Girl projects. Other examples can be found in Scotland [16], where all engineers involved in the construction of Forth Bridge were strictly females, during World War I-World War II where female enrolling in engineering popular schools was described by "invasion" (Bix 2000), and boosting productivity (Douie 1950; Hart 2007).

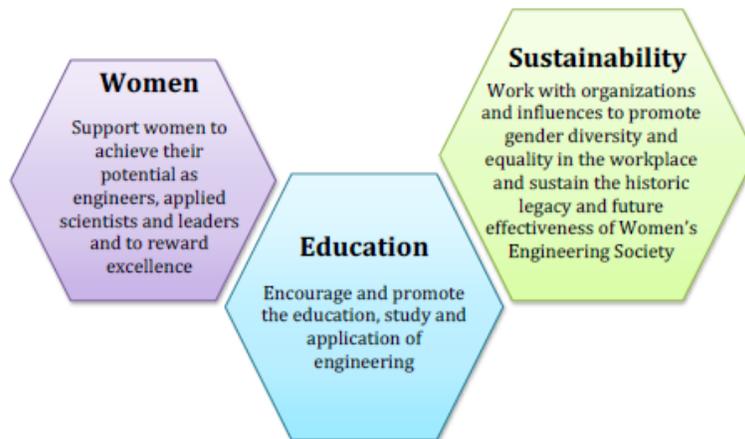


Figure 1. Women Engineering Society's targets [9]

All efforts are considered as paths to proficiency through learn from disapproval and be inspired by others' success. As a result, although negative stereotypes question females' abilities, they manage to endeavor, surpass all difficulties and strengthen their personality through stages of maturity.

College of Engineering (CENG) – Qatar University

Qatar University (QU) is the first national College of Education of the State of Qatar founded in 1973. Hence in 1977, Qatar University was founded with four new colleges, namely Education, Humanities & Social Sciences, Sharia, Law & Islamic Studies, and Science. The College of Engineering was later established in 1980. In its first year the college admitted 57 male and 93 female students. Currently, CENG is a house of six academic departments for undergraduate programs: Architecture and Urban Planning, Computer Engineering and Industrial Engineering, Civil Engineering, Mechanical Engineering, Chemical Engineering, Electrical Engineering and Computer Science. Over the years CENG experienced slow enrolment growth until women were admitted in 2002. CENG displays active participation in research, by establishing collaborations with more than 70 Qatari and international research institutions. [17].

Figures 4-9, describe the demographic profile of CENG students by gender.

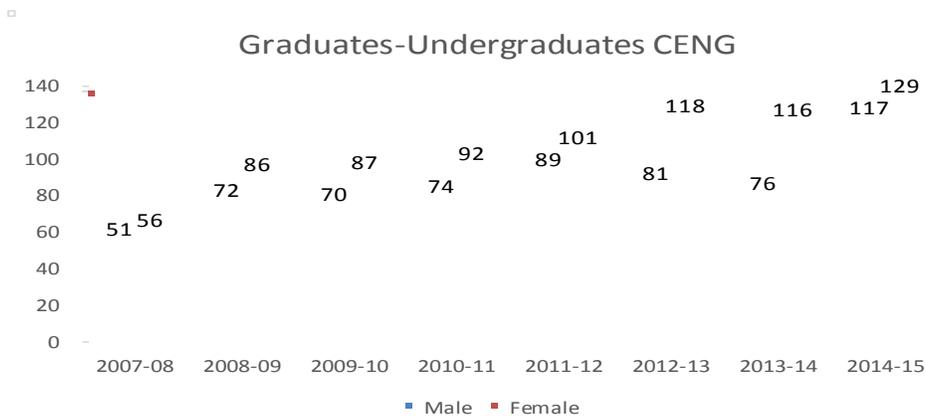


Figure 4. Number of CENG Graduates –Undergraduates Students

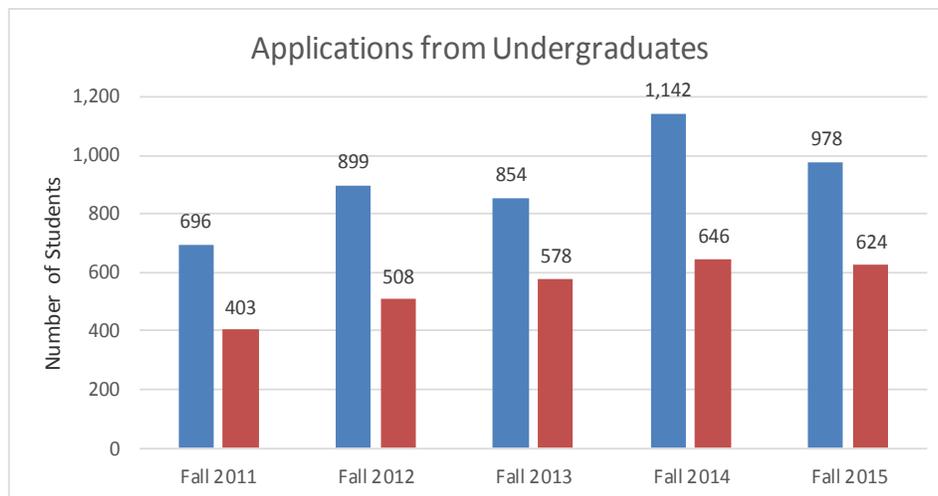


Figure 5. Number of students applying at CENG

Gender classification (Figure 4), reveals that female presence in CENG is continuously rising throughout all 8 academic years (from 2007-2015) by 130% with almost the same rate as males (129%) with 2013-2014 the year were females were found to be 40 more than males. From 2011 until 2014, female applicants in CENG have been steadily growing with a rate of approximately 60%, while the overall increase from 2011 to 2015 was 55% (Figure 5).

Throughout 2011-2014 among registered students, males were continuously more than females, until Fall 2015 when for the first time females were 19 more than males (Figure 6)

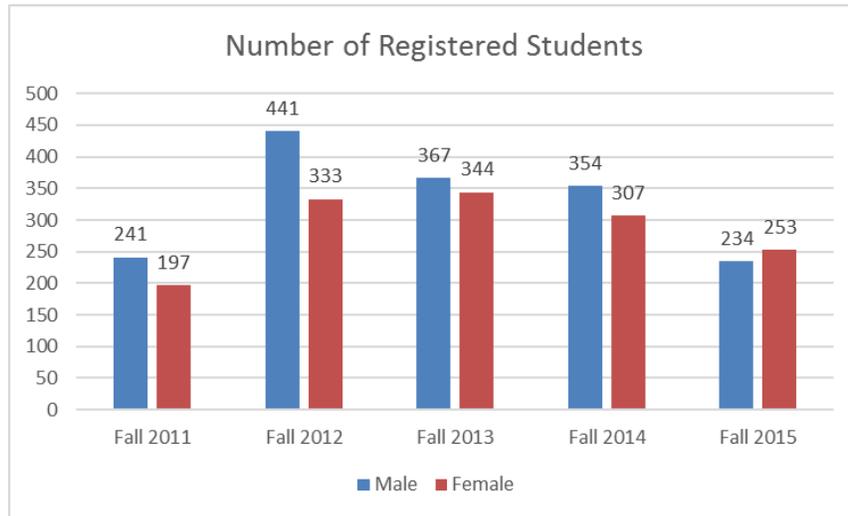


Figure 6. Number of Registered Students

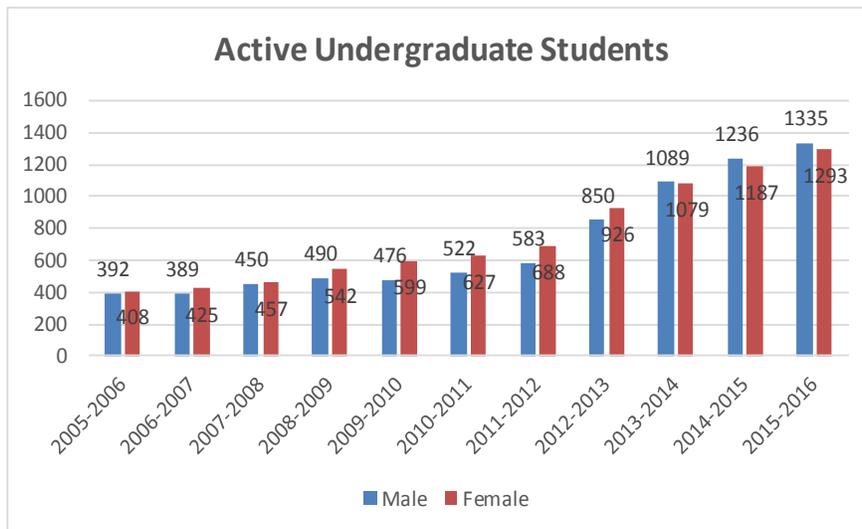


Figure 7. Number of Active undergraduate students

From 2005 until 2013 female engineers appear to be more active than their male peers with the difference in 2010-2012 period to be up to 150 more females. The very next academic year this difference fell (to 76) whereas in 2014 until 2016 males appeared to be more active than females (Figure 7).

Advanced extracurricular participation, higher civic engagement and activism can lead to advanced academic performance (Perez et al. 2010), by inspiring students with higher self-esteem, and motivation to continue learning (Eccles and Barber 1999). Under this light, CENG encouraged students' participation in contests, training and conferences, that referred to locally, regionally and internationally actions, specially designed to promote expertise among engineering students.

Figure 8 illustrates the number of students participating in contests, training and conferences and Figure 9 the obtained GPAs by both male and female students. In 2013-2014 although participating males were doubled than females, the latter obtained overall higher GPAs over two continuous academic years. Experience gained from such events benefited girls to perform more adequately than boys, although lower percentage of participation. In 2014-2015 female participation was more than doubled exceeding that of males, with the GPA performance to be increased as well up to 'B' grade, proving that female engineering dynamics is continuously grown and developed through such participations. During the present academic year females' event and competition involvement has already surpassed that of males, indicating higher future GPAs.

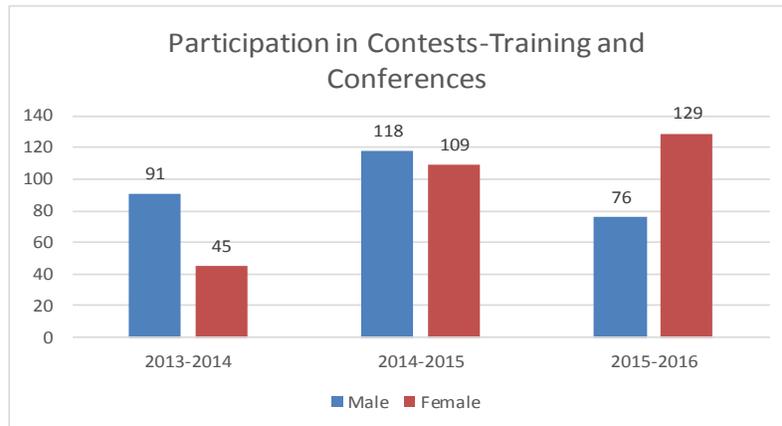


Figure 8. Number of Student Participants in Contests Training and Conferences

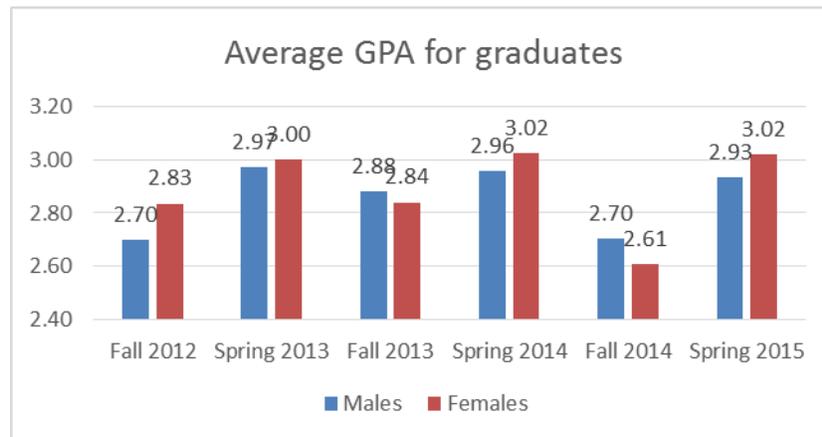


Figure 9. Average GPA by Gender

Conclusions

The importance of the research reveals the advantages and special characteristics that describe women engineers. High self-esteem, confidence, self-reliance, understanding, compassion, advanced sense of ethics, interests in researching, and designing, advanced competitiveness in software operating, and ability in troubleshooting problems, are the most salient and noticeable domains that make female engineers equal or even higher than their male colleagues capable of fulfilling demanding projects. Focusing on the present Qatari industrial and constructing based economy, the nurturing of female engineers is a task of high importance; emergence of 'alpha girls' and female emotional engineering (through emotional business and blue ocean strategies), will lead the industries in the future and help them face the challenges. Predominate misleading perceptions among teenagers that math and science prowess is inherent and therefore engineering is gender oriented are being degrade; engineers are made, not born, and recruiters should inculcate females towards this direction. All in all, the key issue appears to be 'motivation' (Fingleton et al. 2014).

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