



## Highlighting the Need for Engineering Education for Females in Saudi Arabia

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Although Saudi Arabia currently holds some of the leading academic institutions in the Middle East as proven by international rankings, particularly in the engineering and scientific disciplines, there is also almost an absence of major engineering specialties for females. This paper highlights the near nonexistence of engineering education for females in Saudi Arabia (with the exception of the newly-integrated single program in King Abdul-Aziz University), why it is almost absent, as well as the different academic, job-related, and cultural justifications for this phenomenon. It also subjectively compares it with similar models existing in nearby gulf countries, as evidenced by the superior performance of female engineers in recent GCC engineering competitions. This paper finally proposes a plan of action possibly utilizing current education technologies that could be taken to promote engineering education in Saudi Arabia.

Key words: Engineering, Education, Saudi Arabia, GCC

#### **Introduction**

Saudi Arabian higher education currently holds in its 25 public universities<sup>1</sup> one of the largest number of students in the Middle East, now exceeding an impressive 700,000 in total (a large percentage of which is females), with tens of thousands currently as expatriated students in about 25 different countries worldwide<sup>2</sup>. Furthermore, three among the oldest, largest, and most prestigious Saudi public universities, King Abdulaziz University (KAU), King Fahd University for Petroleum and Minerals (KFUPM), and King Saud University (KSU) are now well among Asia's top 100 universities, respectively scoring 49<sup>th</sup>, 62<sup>nd</sup>, and 77<sup>th</sup> according to the latest 2013 THE World University Rankings<sup>3</sup>, which serves to demonstrate the currently distinctive "teaching, research, knowledge transfer and international outlook" of Saudi higher education.

It is therefore surprising to learn that during a fifty year-plus period there are have been (and currently exist) very few female students enrolled in engineering programs anywhere around the country, whether in public or private universities, and for both graduate and undergraduate levels. The aim of this paper is to briefly shed some light on this phenomenon and try to analyze its justifications, as well as suggest means by which this gap could possibly be overcome in the near future.

## **Engineering Education for Females in the US**

STEM (Science, Technology, Engineering, and Math) education is, unsurprisingly, a dynamic issue that is currently being heavily analyzed and targeted by educators in the US and around the world. Recent studies (conducted by the NSF and others) show that although there is a continual interest among US females in STEM education, they are still greatly underrepresented, currently earning no larger than 20% of the number of bachelor's degrees in such fields<sup>4,5</sup> and less so (18.4%) for engineering<sup>6</sup>. This is mainly attributed to social and cultural stereotypes rather than physiological or academic justifications, as evidenced by superior results of opinion surveys and achievements for female students in various pre-collegiate levels in math<sup>4</sup>.

## **Engineering Education for Females in the Gulf Area**

When focusing on female engineering education in Saudi Arabia, it is perhaps a good idea to first extend the discussion to the entire Gulf Area, which shares many historical, geographical, cultural, social, religious, economic and other ties to Saudi Arabia. A recent survey-based study conducted on 2,600 female students (in addition to parents and stakeholders) in the United Arab Emirates shows the movement towards recruiting female engineers in the ever-growing push towards a “knowledge-based” UAE economy<sup>7</sup>.

The study comes to conclusions similar to those attained from the US, whereby it is believed that mainly various cultural stereotypes, family influence, and the scarcity of engineering programs in UAE universities are all contributing to the under-representation of females in STEM education, and more particularly so in engineering disciplines<sup>7</sup>. The study also suggests some methods that can promote female engineering education, via various media and other conventional methods, mainly targeted towards disproving such unsuitability and “adapting” females to engineering norms that don't contradict such cultural and religious values.

The increasing potential and involvement of Gulf-area females in engineering is additionally demonstrated at the graduation level via the participation of females from the six GCC (Arab-Gulf Cooperation Council) countries (including Saudi Arabia) in the first three annual Engineering Students Design Competition<sup>8</sup>. 116 senior design projects pertaining to different engineering disciplines (Civil, Chemical, Industrial, Electrical, Mechanical, and Petroleum Engineering) yielded female winners in each of the 2011, 2012, and 2013 competitions, respectively, 1<sup>st</sup> place draw-winners in EE-Kuwait and ME-UAE; 2<sup>nd</sup> and 3<sup>rd</sup> place respective winners from Qatar and UAE; and 2<sup>nd</sup> place winners from EE-Qatar<sup>8</sup>.

## **Engineering Education for Females in Saudi Arabia**

The following analysis first shows relevant statistics regarding female engineering in Saudi Arabia, followed by various justifications for this, and finally some recent signs of improvement and interest towards possibly resolving this issue.

**Recent Statistics.** Engineering education in Saudi Arabia has recently (2013) celebrated its 50<sup>th</sup> birthday, rising steadily from 17 students in the first engineering college in KSU (1962)

to currently more than 18,000 students in 18 engineering colleges nationwide<sup>9</sup>. However, discipline- and figure-wise, engineering education in Saudi is almost exclusively restricted to male, Saudi students. This is evidenced by various statistics produced in the latest annual manual produced by the Saudi MOHE, particularly to those pertaining to the female involvement in the “Engineering, Manufacturing, and Construction (EMC) fields.” These results are summarized below<sup>10</sup>.

Available EMC programs for females are 12 at the bachelor’s level (compared to 114 for males), and a combined 20 at the master’s and doctorate levels (compared to 72 for males). Only 30,000 females have been enrolled in such fields in the years 2008-2012 as compared to almost 296,000 males, i.e. an almost 1 to 10 ratio, with an average 1% annual increase according to these official figures. Furthermore, throughout the years 2007-2011 only 4,000 female engineers have graduated from Saudi universities versus almost 66,000 males, i.e. an almost 1:16 ratio, yet with an impressive average annual growth rate of 6.1%. This gap is further amplified when considering the number of female students studying abroad throughout the years 2008-2012, totaling 3,300 versus 81,500 males, i.e. an almost 1:25 ratio, yet with a very impressive average annual growth rate of 48.0%.

**Justifications.** As with the US and Gulf models previously discussed, such under-representation is analyzed by researchers<sup>11</sup> of female education in Saudi Arabia and the Saudi MOHE<sup>12</sup> as pertaining to the “historical socio-economic” factors<sup>11</sup>, higher education policies, stereotyping, gender-related household responsibilities, career-related conditions, politics, and the “role of researchers in society”<sup>12</sup> in Saudi Arabia. Such gap is also described as accounting for the near non-availability of engineering-related careers for females, mostly due to the common notion that complete segregation is required between males and females in such a male-dominated workplace. Until today, such factors force many parents who are open or enthusiastic to their daughters acquiring degrees or jobs in various engineering fields to mainly having to resort to sending them to other countries for engineering education and/or employment<sup>11</sup>. The MOHE report, thus, suggests that concerned government officials in higher education should actively engage in narrowing this gender gap in EMC programs.

One such official, Dr. Hamed AlSharari -esteemed member of the Saudi “Shura” (consultative) Council- was asked to deliberate on these justifications as well as on the segregation between males and females in both higher education and the workplace; an email communication<sup>13</sup> with him can be translated, summarized, and paraphrased as follows,

1. Some Saudi engineering colleges have already established programs for females in specializations that do not require field work in prospective careers, such as interior design and computer science; examples include KAU, KSU, and King Faisal University (KFU).
2. The currently varied and numerous job opportunities available for females in the healthcare and educational sectors, in addition to the gender segregation (as dictated by Saudi law) has resulted in a female drift towards the programs leading to such careers.
3. Due to the fact that Saudi Arabia can still be considered a developing country, most of the ongoing engineering projects are oriented towards infrastructure development

- and construction, and mainly depend on field engineers; such work environment is not considered suitable for females in accordance with the conservative Saudi values.
4. In view of gender segregation in Saudi Arabia, engineering schools were not initially designed to accommodate both males and females, unlike medical and education schools which were inclusive to both males and females during their establishment.
  5. Recently, with the alarming increase of unemployment rates among females (around 35%)<sup>14,15</sup> and subsequent decline of career opportunities in the healthcare and education sectors, females have consequently drifted towards engineering disciplines that do not require field work in prospective careers, in accordance with the Saudi cultural values.
  6. This drift is hindered by the previously mentioned fact (number 4. above) that engineering schools in Saudi do not accommodate coeducation, a matter that has alerted the Saudi Shura Council, as described below.

**Promising Signs.** There are various promising signs of the possible increase in interest and enrollment of Saudi females in engineering. There is a belief that the gender-based segregation aspect currently existing in Saudi Arabia could indirectly play a role in promoting female interest in STEM. This is evidenced by recent statistics that show that 80% of female students in Saudi Arabia are interested in engineering. This could be considered to greatly exceed such interest as compared to their US or UK counterparts, as evidenced by the percentage of annual female graduates in engineering from US (19%) and UK (15%) universities, which foster co-education<sup>16</sup>.

There are also recent, active signs of this interest. The Saudi Shura Council has just recently issued a decision/invitation to the Saudi MOHE (in coordination with associated parties) to present forth a short-term plan regarding the expansion in the acceptance of male and female students in equal numbers in the health science and engineering disciplines<sup>17</sup>.

Furthermore, KAU launched the first-ever public engineering program for girls in Saudi Arabia at its girls' section in the fall semester of 2012, which consisted of about 60 students<sup>18</sup>. Newly joined female engineering students at KAU are expected to specialize mostly in Electrical and Industrial Engineering, according to a feasibility study conducted to evaluate market and policy-maker interest for female graduates in various engineering fields. Furthermore, Effat University has recently partnered with Duke University to establish the first engineering program in a women's university<sup>19</sup>.

The Saudi Council for Engineers has in recent years also witnessed increased female participation. This is evidenced by the appointment of the first lady engineer (an 83-year-old architectural engineer) after winning the elections for appointing council members<sup>20</sup>. Furthermore, in 2006 the SCE also appointed seven female Saudi engineers in its first-ever female committee<sup>21</sup>. Female engineers are also actively being recruited in various Saudi companies, most prominently in the famous *Saudi ARAMCO* oil company.

## Suggestions to Promote Engineering Education in Saudi Arabia

The above evidence and statistics beg reconsideration for females in STEM education and particularly in engineering education in Saudi Arabia. It is first proposed that an institutional, widespread, funded study needs to be undertaken to test the feasibility and need for integrating female engineering education first in undergraduate programs in peer Saudi public universities (such as KSU, KAU, KFUPM, and KFU). This one- to two-year study would aim in studying factors similar to those investigated by the UAE study described earlier<sup>7</sup>. Results would help clarify issues including which disciplines are most popular and why, if females would (or would not) and why (or why not) they would consider careers in engineering. The study would be distributed to thousands of girls in high schools nationwide, as well as a diverse sample of parents of such girls. In addition, stakeholders and influential figures in the Saudi community should be asked to offer their opinions (men and women) on the matter; this should include Princess Nura University (which is also an all-female university) and Effat University presidents, deans, and professors, various Saudi Shura Council members (women and men), and other important and public, political, religious and other influential figures in the society.

Engineering education for females can also slowly be promoted and integrated into Saudi universities without the need for co-education or direct instruction of girls by male professors. This can be initiated by constructing a separate engineering college campus (such as the KAU one mentioned above), and actively recruiting (as is being done in PNU) engineering female professors (Saudi and non-Saudi) for this task. If male intervention or instruction is required, girls would be instructed by broadcasting lessons live from the nearby male campus. Experienced female technicians/engineers should be hired for the different engineering labs.

It is proposed to also establish fundamental, online courses aimed at attracting scientifically-motivated girls to evaluating and developing their high-school acquired levels in Math and Physics, as well as encouraging them to develop basic engineering skills. Similarly, qualification tests currently being administered to males for entering engineering colleges could also be given to females, even if initially on a voluntary/experimental basis. This could help in performing a valuable comparison between male and female level readiness and advent for higher education in engineering.

Finally, it is encouraged that Saudi authorities should perform an active role in encouraging females to engage in engineering and STEM education in general. Such could be promoted through social media and the Internet, and by highlighting successful models of Saudi and GCC female engineers whether in academia or in engineering careers.

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