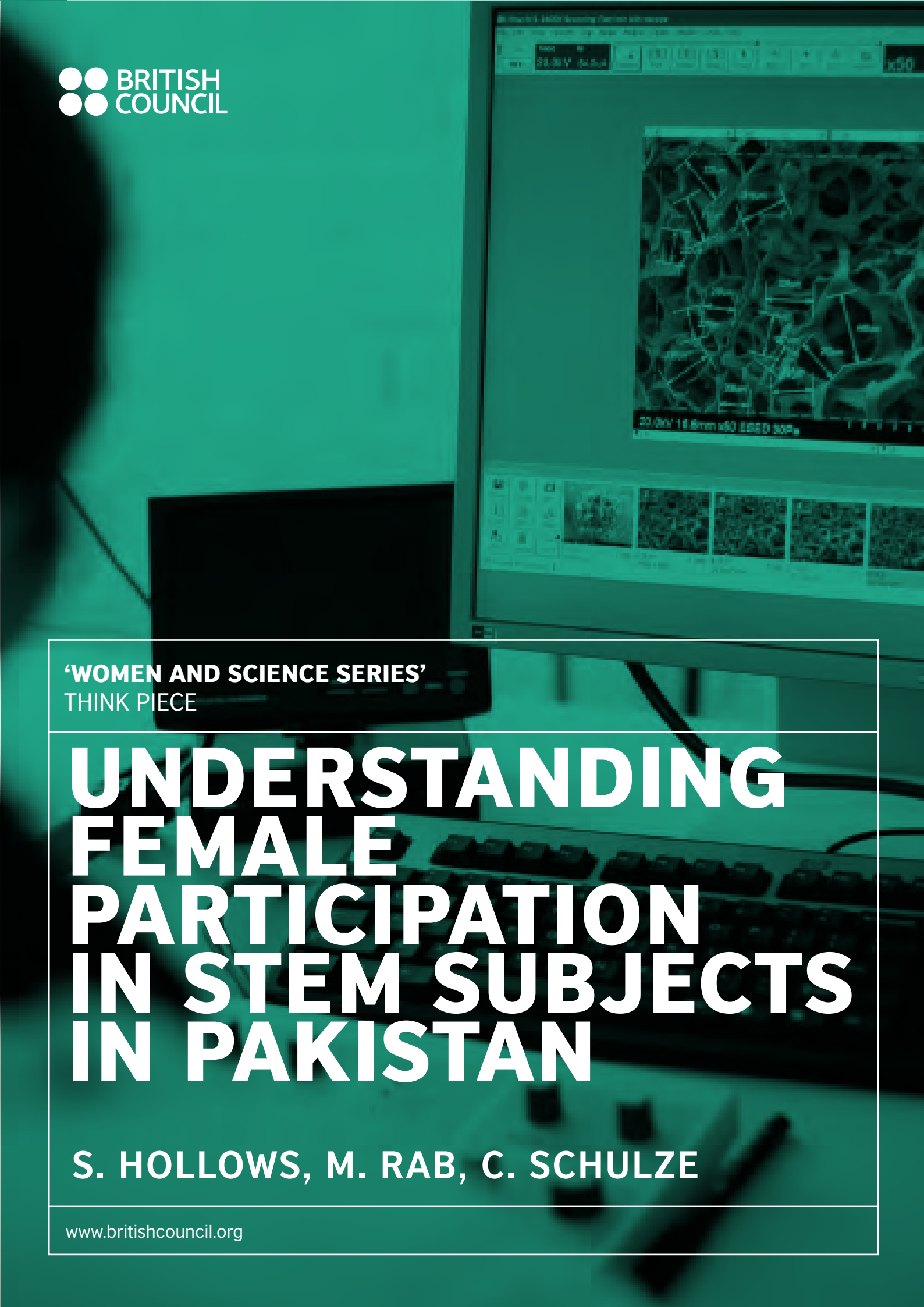

BRITISH COUNCIL

'WOMEN AND SCIENCE SERIES'
THINK PIECE

UNDERSTANDING FEMALE PARTICIPATION IN STEM SUBJECTS IN PAKISTAN

S. HOLLOWS, M. RAB, C. SCHULZE

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WOMEN AND SCIENCE SERIES' - THINK PIECE

Sophie Hollows (British Council)
Maryam Rab (British Council)
Charles Schulze (Carfax Educational Projects)

FOREWARD

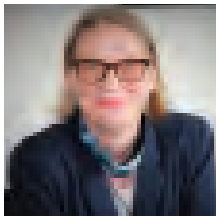
There is a global realisation that science, technology and innovation are central for a more sustainable and prosperous future. This fact is validated by experience of many countries; those have experienced first-hand the transformative power of science, technology and innovation. It is worth thinking how we can harness this power for the benefit of communities, particularly for the most deserving and underserved?

The immense human capacity of Pakistan's young population must be developed in the coming years so that it may be leveraged for the increased prosperity and security of the country. Throughout this, it is crucial to ensure that all types of opportunities are equally available to both boys and girls.
Countries throughout the world have struggled to engage women in STEM subjects. This report explores how this dynamic is at work in the Pakistani context, and what can and should be done to counteract it.

Gender equality is a cross cutting theme throughout the British Council's work, and as we develop STEM education content in Pakistan we will focus on encouraging girls' participation. We will aim to provide support for girls who are interested in STEM and provide them with role models. It is crucial that the women of tomorrow see themselves as key stakeholders in scientific progress and that they are empowered to contribute to it.

Through this report we are able to take the first steps to engage with these issues and to start meaningful conversations. In the coming months and years, we plan to continue this work by developing tailor made solutions for the Pakistani context, and focusing on evidence led programming.
Wishing a better culture for science education and application in coming times

Nishat Riaz



Vibeke Jensen

ABSTRACT

In many countries in South Asia, and in the UK, women's participation in higher education (HE) has equalled or surpassed men's in recent years. However, this trend is not reflected in STEM (Science, Technology, Engineering and Mathematics) subjects. Women are therefore less likely to pursue careers in STEM subjects - arguably this creates an endless cycle as there is therefore a dearth of role models for young women interested in science, technology, engineering and maths.

However, most work in the field that has assessed the reasons for such a disparity and identified potential solutions has focused on developed countries. As a result it does not take into account the unique social and cultural situation in Pakistan and proposed solutions may not be appropriate. Pakistan is at a crucial point in its development, and education has a strong role to play in encouraging further development. Women's education and inclusion in educational institutions is particularly important. In Pakistan, there are increasing numbers of both male and female students enrolling in universities and completing their higher education. Nevertheless, as in other countries, the STEM subjects are disproportionately dominated by male students.

This paper focuses specifically on Pakistan and attempts to identify potential solutions. It draws on extensive fieldwork that the British Council has carried out in the area, including nationwide surveys of teachers, male and female university students and male and female school students, focus groups with female school student and qualitative interviews with teachers and career advisors. In particular, it will focus on why girls who have studied STEM subjects in high school, completing O and A level qualifications or equivalent local qualifications have not chosen to study these subjects at university. It will identify a variety of factors and assess which is most important, and will attempt to explain why women and girls discontinue STEM subjects, suggesting how and why these might differ from more developed contexts. Finally, it will suggest appropriate interventions for the Pakistani context.

Keywords: Pakistan, women, girls, STEM, Science, technology, engineering, maths, British Council, qualitative, quantitative, recommendations, Higher Education, Schools

INTRODUCTION

1.

Throughout the world, the numbers of women enrolling in higher education institutions is growing - by 2008, the gross enrolment rate for men and women had already reached parity in Latin America and the Caribbean, Central and Eastern Europe, East Asia and the Pacific, Central Asia, and North America and Western Europe [1]. However, data from the OECD demonstrated that women consistently study STEM subjects less than men [2]. No country has achieved gender parity in engineering, and in only 3 countries are 50% or more of STEM graduates female [2].

In Pakistan, girls comprise 57% of all out of school children [3] and face systematic discrimination. Though data suggests that rates of enrolment at the tertiary level have almost reached parity in recent years [4], World Bank Data confirms that gender parity remains elusive at all levels of education [3]. Women complete far fewer PhDs than men [5] and are subsequently seriously underrepresented in STEM careers [6].

Negative stereotypes [7] [8], social and peer pressure [9] [10] [11] [12], a lack of encouragement [13] [14] and the perceived marginalisation of women who work in STEM fields [15] [16] have all been identified as factors that discourage young women from pursuing careers in science.. Many theories have also been developed to attempt to explain how these phenomena influence young women and their communities. The first of these is the 'Rational Choice' theory, which refers to the rational decision-making process children and young people use to make decisions during their education. Rational choice attributes these choices to a cost/ benefit analysis, balancing long term utility against short term failure [17]. This theory would suggest that women do not choose to study STEM subjects because they anticipate that either they would fail in the STEM career track, or that it would not be financially or socially advantageous to pursue STEM subjects. 'Gender Socialisation Theory' posits that through a lifetime of interactions, corrections, and occasionally ridicule and ostracism, individuals ultimately learn to comply with a regime of gendered norms [18]. Similarly, the 'Looking Glass Self' theory claims that our self-perceptions do not necessarily reflect our true capabilities but rather what we perceive others' opinions of our capabilities to be [19]. Blickenstaff, meanwhile describes a 'Leaky Pipeline' where women leak out of the potential STEM workforce not because of any intentional discrimination but because of the cumulative effect of 'many separate but related factors' [20].

Various interventions have been trialled to attempt to counteract these sociological trends. Some have advocated for the improvement of the quality of STEM education to counteract a knowledge deficiency [21] [22] and the need to ensure the presence of appropriate science facilities [23], noting that this has positive effects for both boys and girls. Other have recommended that teachers and parents could improve female performance by imposing high expectations [24]. Research has also shown that girls benefit from female specific settings [25] [26] and have advocated more all-girls' institutions as well as science clubs and after school programmes specifically targeting girls. Bix focused on social activism that changed the perception of female engineers and led to more female-friendly workplaces [27].

It remains to be seen, however, whether such interventions would be adequate and effective in a Pakistani setting. This project aimed to identify effective interventions to encourage young women in Pakistan to pursue STEM subjects. It draws on extensive fieldwork undertaken by Carfax Education Projects on behalf of the British Council, including nationwide surveys of teachers, male and female university students and male and female school students, focus groups with female school students and qualitative interviews with teachers and career advisors. In particular, it will focus on why girls who have studied STEM subjects in secondary school or high school have not chosen to discontinue these subjects. It will identify a variety of factors and assess which is most important, and will attempt to explain

why women and girls discontinue STEM subjects, suggesting how and why these might differ from more developed contexts. Finally, it will suggest appropriate interventions for the Pakistani context.

In Pakistan, girls comprise 57% of all out of school children [3] and face systematic discrimination. Though data suggests that rates of enrolment at the tertiary level have almost reached parity in recent years [4], World Bank Data confirms that gender parity remains elusive at all levels of education [3]. Women complete far fewer PhDs than men [5] and are subsequently seriously underrepresented in STEM careers [6].

METHODOLOGY

2.

Whilst there has been some debate elsewhere about which subjects are to be included in the STEM acronym, for the purposes of this study we have relied on the parameters set forward by the British Parliament [28]. These guidelines are closely aligned to the categories used by the British Higher Education Statistics Agency [29]. Figure 1 details the subjects included in this study.

SCIENCE

- Medicine and dentistry
- Subjects allied to Medicine
- Biological Sciences
- Veterinary Science
- Physical Science
- Agriculture and related subjects

ENGINEERING

- Engineering and technology
- Architecture, building and planning

TECHNOLOGY

- Computer science
- Technologies

MATHEMATICS

- Mathematical sciences

Figure 1

This project took a mixed methods approach. During the qualitative element of the research, the consultants drew on trends identified during a literature review to develop semi structured interview protocols for key informants and focus groups to explore the reasons why young women do not pursue STEM subjects at university or STEM careers. 23 focus group discussions were undertaken, with a total of 127 participants. Of these, 11 were male and 116 were female. 9 key informant interviews undertaken, with 1 man and 8 women.

The quantitative element of the research involved surveys for three sets of stakeholders: secondary school students, university students and school staff. The purpose of these was to ascertain when young women 'leak' out of the STEM pipeline and to develop some awareness of why they do so. Overall, 2220 secondary students completed the first questionnaire. 65% of the secondary students were female, and the remaining 35% were male. 720 university students completed the second questionnaire. Of these, 90% were women and 10% were men. 282 school staff members - teachers, head teachers and career counsellors- completed the third questionnaire. 75% of these respondents were female and 25% were male.

23 focus group discussions were undertaken, with a total of 127 participants. Of these, 11 were male and 116 were female. 9 key informant interviews were undertaken, with 1 man and 8 women.

CASE STUDY

Jehan Ara, President, Pakistan Software Houses Association for IT & ITES (P@SHA) and The NEST I/O

Profession:
- President, PASHA
- CEO
- Member of Governing Council
- Charter Member
- Managing Director
- Member of several Advisory Boards

Education:
- Bachelor of Arts in Advanced Maths, English Literature & Economics, St, Josephs College

Areas of Interest:
- IT,
- Blogging,
- Music,
- Travelling

Member of Advisory boards:
- Institute of Business Administration (IBA)
- Punjab Information Technology Board (PITB) Plan 9 Incubation Center
- LUMS Center for Entrepreneurship
- Habib University

Jehan Ara humbly describes herself 'as a person of average intelligence' on her blog site (Ara, 2007), however she is in fact one of the most respected professionals in Pakistan's burgeoning tech industry (Husain, 2015). She is the president of the Pakistan Software House Association for IT & ITES (P@SHA) and is often cited as having single-handedly developed the P@SHA brand, establishing relationships between the organisation and local and international partners. P@SHA is now the only tech association in Pakistan (Husain, 2015). It is also the sole non-profit organization voicing the concerns of the Pakistani IT industry in the global arena. Its primary aim is to promote and develop the software and services industry in Pakistan and to protect the rights of its members (Husain, 2015). Jehan is also The Big Bird at The Nest i/o which is a technology incubator set up by her in Karachi in January 2015 to promote entrepreneurship and support aspiring young entrepreneurs.

With over 30 years of experience in marketing, communications, and interactive new media in Hong Kong, the Middle East and Pakistan, Jehan believes in using cutting edge technology to address social and global software issues (PASHA, 2016). She has also done

extensive work to leverage the power of technology to improve women's lives in Pakistan. For example, she was one of the primary drivers of the Take Back the Tech initiative in Pakistan which aims to create awareness and develop technology that can be used to end violence against women and girls (P@shafund, 2011). She is also involved in other initiatives such as Women's Virtual Network, which seeks to connect qualified women with potential employers, mentors, and peers in order to promote and support women's participation and transition within the economic sector of the country (P@shafund, 2011).

In addition to her work supporting women in Pakistan, Jehan also advocates for appropriate legislation on cyber-crime and data privacy and protection. She is currently also part of the 'Bolo Bhi' initiative, an organization focused on research-backed advocacy for a wide range of social issues (PASHA, 2016).

With over 30 years of experience in marketing, communications, and interactive new media in Hong Kong, the Middle East and Pakistan, Jehan believes in using cutting edge technology to address social and global software issues (PASHA, 2016). She has also done extensive work to leverage the power of technology to improve women's lives in Pakistan.

QUALITATIVE DATA

3.

The focus group discussions and in depth interviews focused on the factors that influence young women as they determine what subjects to pursue in school, and at university. Many of the reported factors closely aligned with dynamics seen elsewhere and identified in the literature review - clear social and cultural factors are at work and many of the theories that have been posited to explain the underrepresentation of women in STEM subjects and careers around the world would appear to be relevant to the Pakistan context. For instance, the need to be pragmatic when choosing a career was considered a factor in 90% of conversations with students, and 63% of conversations with educators and career counsellors. STEM career tracks were not seen to be as profitable or reliable, with the exception of medical careers. This was likely closely tied to the concern about the high levels of competition in STEM careers- competition was mentioned in 40% of conversations with students and 11% of conversations with teachers and career counsellors.

The focus groups also demonstrated that dynamics associated with 'Gender Socialisation' and the 'Looking Glass Self' might be at work. In 100% of the focus group conversations with students, the young women expressed concerns over their natural ability, suggesting that their male counterparts would be more naturally gifted at STEM subjects. 63% of the conversations with school staff members also noted this was a factor for young women. Concerns over natural ability are also often accompanied by a concern that young men would be more advanced or have more knowledge of STEM subjects. In 50% of the conversations with students and 21% of the conversations with educators and guidance counsellors, it was considered that a perceived knowledge and opportunity gap would be a factor for young women considering STEM subjects.

The focus groups and interviews also revealed some factors that might be expected to be important to young people throughout the world. In 30% of the conversations with young women, the desire to pursue a career that would benefit their country or society was mentioned. In 50% of conversations with young women and 21% of conversations with teachers and career counsellors concerns were expressed over poor teaching in STEM subjects. Guidance counsellors were also seen to be underprepared. One guidance counsellor said when they started their career 'I had no guidance. Google was the main source of information for me- I have learned through doing, albeit hit or miss.'

Alongside factors that would be expected to emerge throughout the world, there were some concerns that appear to be more specific to the Pakistani context. Though these can also often be seen through the lens of an existing, universal theoretical framework, a more detailed analysis suggests dynamics that are more particular to Pakistan. One example of this is traditional gender roles and the associated social and cultural expectations. These expectations were cited as factors in 100% of the focus group discussions with students and 53% of the discussions and interviews with educators and counsellors. As one university principal put it, 'It is about socialisation - women are brought up to serve their family, their husband, then children. If a man marries a doctor, she will then look after the mother in law'. Indeed, the students often referred to the question of marriageability and the role that higher education might play into their ability to attract a husband. As one public school teacher noted '75% of parents want girls to have easy subjects to marry them'. Though gender roles would be expected to influence young women's decision making, and are considered in theoretical explanatory approaches like gender socialisation and 'the looking glass self', it seems striking that the question of marriage and eligibility is so present and easily acknowledged. It is not influencing decision making in a subliminal manner.

In 50% of the conversations with students and 21% of the conversations with educators and guidance counsellors it was considered that a perceived knowledge and opportunity gap would be a factor for young

women considering STEM subjects.

The young women's perspectives on marriage, subject choice and career choice also provide some insight into the status of medicine as an outlier. As one young woman put it 'They say that if you are a doctor you will get good proposals. Not everyone, but a lot of people say that to their daughters.' In Pakistan, medicine is oversubscribed by women, however many of them do not practice medicine after university. The Pakistan Medical and Dental Council (PMDC) has indicated that 50% of female medical graduates never work following their studies [30] [31]. While 70% of medical students are women, only 23% of registered doctors are women [31]. In response to this, a quota for male students has been introduced in the medical sciences [31]. One young woman in a focus group seemed to suggest that medical degrees make women more eligible because of associations with social skills and civic duty, saying 'Doctors help people; this is why lady doctors are so appreciated in the marriage market. It is one reason why a lot of parents push their children to pursue Medicine.'

In turn, familial expectations were considered to be a crucial factor for young women when they were considering options for their future. This was mentioned in 60% of the interactions with students, and 63% of those with educators and counsellors. Though this is likely an important factor in any context, the young women in our focus groups specifically focused on the expectation to have children, and then give up work. As one female student said 'You have to have children - families will have a problem if you wait too long to have children. They also think you are neglecting your children if you work too much, but it is ok for men to 'neglect''.

Parents' influence seemed to be particularly strong - in both types of focus group the role of parents was cited 90% of the time. Parents were seen to be more concerned with their daughter's marriageability than their daughters, and also to often see STEM subjects as too challenging for young women.

One guidance counsellor said 'I had no guidance. Google was the main source of information for me- I have learned through doing, albeit hit or miss.'

Socioeconomic factors also play a clear role - many young women noted that more educated parents with higher incomes were more likely to allow or encourage their daughters to pursue STEM subjects. A final factor that appeared to be exacerbated by the Pakistani context was the notion of appropriate workplaces and study environments. This was cited in 70% of focus groups with students and 63% of focus groups with educators and counsellors. Engineering and other STEM related careers and subjects are associated with field work and long hours - both of which can be seen to be unacceptable for a woman. One focus group participant gave an example of having to stay in the office until 10 pm to finish a project, and described how her parents considered that to be unacceptable.

Focus groups and discussions with students, educators and career counsellors also revealed some factors that emphasised the inequality of educational opportunities in Pakistan. Girls' education is treated as a luxury. As one female student noted 'I have family friends who have sent three boys to Cambridge schools and three girls to government schools. The parents wouldn't let the girls go to O level schools they assume they will have filthy rich husbands. This happens all the time.' 60% of interactions with students and 37% of interactions with teachers and counsellors mentioned the cost of education for women. 50% of student focus groups and 50% of educator and counsellor focus groups also suggested that women would be less likely to be given the opportunity to study abroad, and that this would also affect their subject choice.

The Pakistan Medical and Dental Council (PMDC) has indicated that 50% of female medical graduates never work following their studies [30] [31]. While 70% of medical students are women, only 23% of registered doctors are women [31]. In response to this, a quota for male students has been introduced in the medical sciences [31].

CASE STUDY

Ramla Qureshi, Master's Student & Founder of Women Engineers Pakistan (WEP)

Profession:
- Student & Founder of WEP

Previous positions held/Experience:
- CEO
- Member of Governing Council
- Charter Member
- Managing Director
- Member of several Advisory Boards

Education:
- Master's Degree in Engineering (Structural and Earthquake Engineering), University of Buffalo, New York*
- Bachelor's Degree in Engineering (Civil Engineering) NUST, Islamabad.

Areas of Interest:
- Advocacy, and
- Stringent laws to prevent workplace harassment.

Ramla Qureshi is a Master's student specialising in the field of Structural and Earthquake Engineering. Though only 25 years old, Ramla, alongside her master's degree, is the founder and manager of Women Engineers in Pakistan (WEP), a successful non-profit organisation that works to encourage female participation in Science, Technology, Engineering & Mathematics subjects (Qureshi, 2016). The organisation's ultimate aim is to facilitate the integration of Women engineers and aspiring students within the education and business environments in Pakistan (Qureshi, 2016).

Ramla started WEP in 2014, having completed her Bachelor's degree in Civil Engineering at NUST in Islamabad. What started as a Facebook page to network and share insights amongst women pursuing careers in Engineering fields in Pakistan, soon turned into an active organisation seeking to help women through a three-fold programme involving creating awareness among high school students in underprivileged areas, supporting and providing guidance about engineering careers to students already in field and engaging successful women engineers and professionals as mentors in workshop programmes for girls. Although the organisation is only two years old, Ramla and her team are already working with universities

and institutes in three cities in Pakistan, with the hope of reaching out to two more cities by the end of the year.

Ramla supervises and manages the organisation whilst simultaneously working on her Master's course in the United States. When asked about balancing her commitments, she stated she was happy to do so as it gave her a 'feeling of purpose … [and] … getting something done at the end of the day [for the cause]'. When she completes her Master's, Ramla plans to continue her career in engineering in Pakistan whilst also developing WEP's capacity to provide skills training and career guidance for more women and Engineering students in the country.

Ramla mentioned facing many of the challenges discussed in other sections of this study: as a female student of Civil Engineering, Ramla like the other female interviewees found herself to be one of 10-15 female students within a class of 200 students. However, instead of relenting to feelings of isolation, she adapted to the context:

'In such a ratio, it's very difficult for girls to group together, […] if the batch was divided into three sections, then each section gets what? 3 girls? You can't form a group with 3 girls, so we had to adapt, and we understood what it was to work, and we sort of navigated through that. […] We started group studies with the boys, working in societies and students' blogs and stuff like that so that we knew more people beyond our subjects.'

Ramla dealt with pressures similar to those discussed by other respondents, with relatives and friends frequently doubting and questioning her future career prospects in male-dominated Engineering subjects. These challenges motivated her to found WEP:

'I was like 'Aunty, that's not what I do, that's the job of a mason, I am an engineer, I sit in the office', and that's when it hit me – the laymen, the normal people, have no idea what Engineering is or does. [….] Even recently I received an email from a girl, who is about to enter Engineering and is being severely discouraged by her friends and family […] and she thinks that since engineers travel a lot to different sites, she won't be able to do that.'

WEP, along with its efforts to promote awareness about opportunities for Pakistani women in Engineering, advertises about relevant competitions, job opportunities and training programmes on their website (Qureshi, 2016). Ramla is frequently invited to speak at schools and youth programmes, to share her life experiences and encourage students, especially girls, to pursue STEM-focused education and careers. Most recently, Ramla was invited by an NGO as 'Hero Speaker' to inspire both girls and boys about STEM careers. She previously spoke at the National Youth Conference, 2014 held in Karachi (Qureshi, 2016).

QUANTITATIVE DATA

4.

There are many challenges associated with collecting quantitative data in Pakistan, and it is crucial to be aware of the limitations of our data before embarking on any analysis. Our data was primarily drawn from urban contexts. Equally, though there were efforts to collect data from all regions of Pakistan, there were no survey respondents from Balochistan and only 1% of one type of survey respondent from the Federal Administered Tribal Areas (FATA). Significantly for this study, the survey respondents were overwhelmingly female.

The quantitative data also supports the 'leaky pipeline' notion. The decline in women studying STEM subjects is gradual and happens over the course of several years. The educational profiles can be analysed by looking at the numbers of young men and women studying STEM subjects for their secondary school certificate, and then by comparing this to the number of young men and women studying STEM subjects for their higher education certificates. This is the education system followed by public, government schools in Pakistan. A similar comparison can be made for the subjects studied by young men and women at GCSE/O level and subsequently at A level.

At the secondary school certificate level, there were minimal differences between the STEM subjects studied by male and female students - girls studied an average of 3.14 STEM focused classes, and boys studied an average of 3.26. 96% of girls were enrolled in at least one STEM subject, and 99% of boys were. This is likely because many STEM subjects are compulsory at the secondary school certificate level. At the High School Certificate level, the differences become more pronounced. None of the top 5 subjects studied by girls were in the STEM field, and 3 of the top 5 subjects studied by boys were STEM related. 47% of girls were enrolled in at least on STEM class and 72% of boys were. This would appear to suggest that as young women are able to exercise more control over the subjects they study, the less likely they are to choose STEM subjects. There is a similar trend between GCSE exams and A levels. At GCSE exams, girls were enrolled in an average of 1.7 STEM subjects, and boys were enrolled in an average of 1.93. Though there was only a very limited sample of students studying A levels who

Figure 2

Figure 2

responded to the questionnaire, similar dynamics are evident. At A level, this drops to 1.31 STEM subjects for young women, and 1.64 STEM classes for young men. At A level, 42% of girls were taking at least one STEM class, and 73% of boys were. By the time students reach the university level, 26% of women are enrolled in STEM courses and 51% of men are. Though the number of boys studying STEM subjects also declines, there is a much more significant decline in the numbers of girls studying STEM subjects.

Arguably, this difference is even more notable when the anomalous status of medicine is considered. Indeed, the exceptional status of medicine was confirmed by the quantitative data. At Secondary School Certificate level, High School Certificate level, O level and I/GCSE level and A level, women were overwhelmingly more likely to be enrolled in STEM classes that aligned to medical degrees and careers. As the qualitative data makes clear, the number of young women studying medicine does not reflect a wider societal acceptance of women's engagement with STEM subjects or STEM careers.

The quantitative data also sheds additional light on the complex socioeconomic dynamics at work in Pakistan, suggesting that interventions that might be appropriate for some individuals or families would not be effective to bring about the necessary step change in how women are perceived to interact with science, technology, engineering and maths. This is most clear in an examination of the factors that young people consider when they are choosing which subjects to study. In order to understand the role of socioeconomic status on the factors that affect young people's decision making, we have taken type of school as a proxy. Public schools, which offer the secondary school certificate and the high school certificate, are open to all members of the Pakistani public. Meanwhile, students studying O levels/I/GCSEs and A levels are highly likely to be enrolled at exclusive private schools which offer an international curriculum and are only frequented by the elite of Pakistani society.

There is no overlap between the top 5 factors for young women pursuing their Secondary School Certificate and young women pursuing their GCSEs (fig. 3). Different types of programmes or interventions are therefore likely to have more impact with different audiences. This reflects some of the dynamics suggested in the qualitative interviews, but also provides additional insight into which factors are most influential for different audiences and where interventions might therefore be most effective.

Top 5 factors- Girls Pursuing the Secondary School Certificate	Top 5 factors- Girls pursuing O levels/ I/GCSEs
1. Mother's Influence 2. Father's Influence 3. Innate interest/passion 4. Work environment in related fields is more suitable for females 5. Friends' influence	1. Teachers' Influence 2. Greater chance of pursuing these subjects in college/university 3. Male siblings' influence 4. Higher pay in future 5. Career Counsellor's influence

This diversity of important factors is not reflected, however, at the university level. University students also completed the survey, and answered questions about the factors they considered when choosing their degree subjects. For women studying STEM subjects and women studying non STEM subjects, the top 5 factors were identical (fig. 4). This suggests that the most effective time to encourage women to pursue STEM subjects, to counteract the 'leaky pipeline' is earlier in the education system.

Top 5 factors- Female University Students studying STEM subjects	Top 5 factors- Female University Students studying non- STEM subjects
1. Your interest/passion 2. Your own ability/skills 3. Higher pay in the future 4. Greater chance of employability 5. Greater chance of pursuing these subjects in college/university	1. Your interest/passion 2. Your own ability/skills 3. Higher pay in the future 4. Greater chance of employability 5. Greater chance of pursuing these subjects in college/university

Figure 4

Encouragingly, the data also indicated a strong appetite for change amongst young people. When asked if they felt that gendered patterns of subject selection should change, all groups of respondents responded positively. This data is summarised in figures 5 and 6. Overall, 71% of respondents thought that if there were subjects that boys study more than girls, then this should change. 63% thought that if there were subjects that girls study more than boys, then this should change.

If there are subjects that boys study more than girls, do you think this should change?

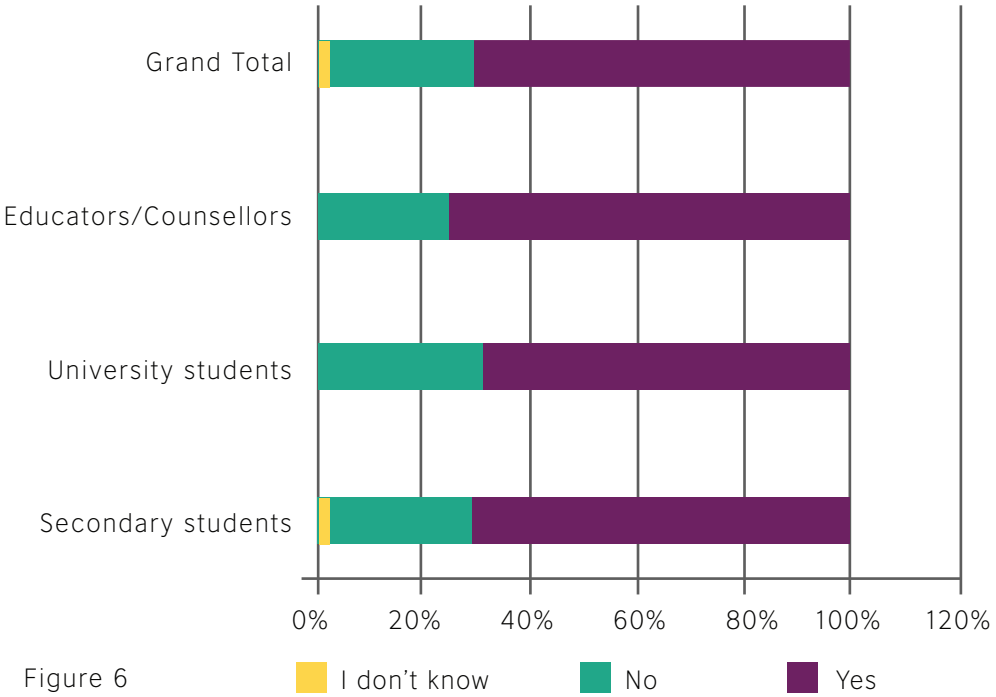


Figure 6

If there are subjects that girls study more than boys, do you think this should change?

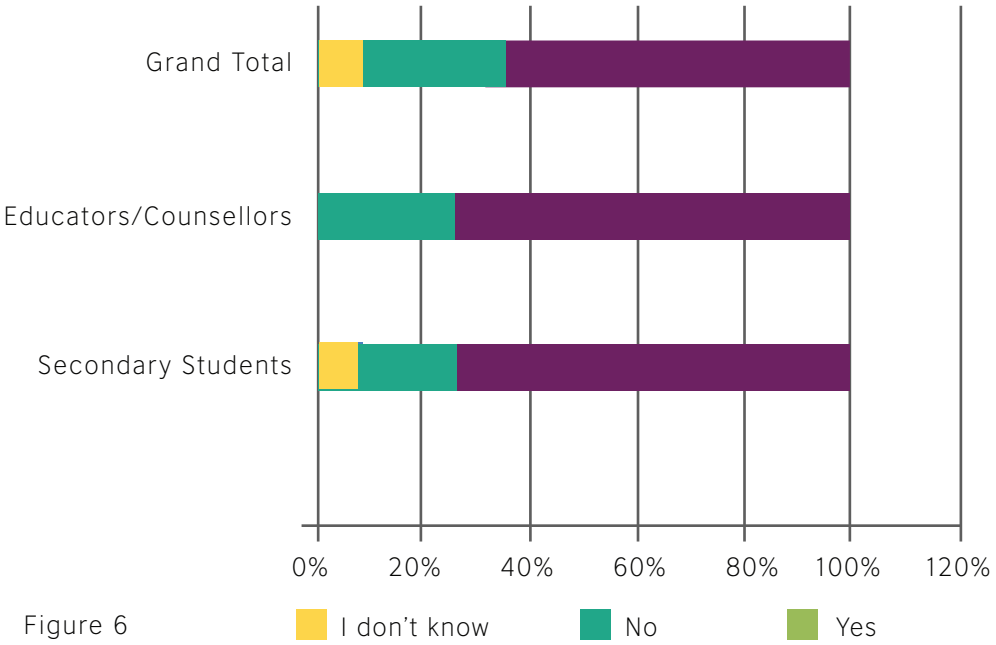


Figure 6

CASE STUDY

Mrs Mumtaz Bashir - Hanid BSc JP DL
Managing Director – Women International Collaborate Company Limited

Profession:
- Managing Director, Women International Collaborate Company Limited.

Previous positions held / Experience:
- Founder, Pre Volunteer Programme for Global Sports Events
- Programme Director -Personal Best 2012 London Olympic & Paralympic Games
- Director – Manchester Employer Coaliton
- Head of Programme – Pre Volunteer Programme for the 2002 Commonwealth Games Manchester
- General Manager of Business Link Manchester

Education:
•BSc. (Hons.) Engineering (Polymer Science and Technology), The Manchester Metropolitan University

Areas of Interest:
- Project Management,
- Leadership
- Social Justice
- Empowerment of women
- Education,
- Public Sector.

An engineer, entrepreneur, and regarded as a social engineer.

Mumtaz Bashir is currently the Managing Director for Women International Collaborate, and has a proven track record of managing multiple programmes across the public, private, and voluntary sectors (Bashir, 2015). She has been a guest lecturer at the University of Manchester, is a member of the National Policy Forum for Women's Enterprise, and is also an advisor to the British Government on Ethnic Minority Issues, Women's Enterprise Agendas, and wider issues in the British and Pakistani enterprise landscape (2016).

As a management consultant in the UK, Mumtaz has worked extensively with global sporting events like the 2002 Commonwealth Games in Manchester (Bashir, 2015). Her primary focus during this event was on economic regeneration programmes in Northern England, work which gained recognition from the United Nations for its impact on social inclusion (Bashir, 2015).

Though Mumtaz was born and raised in Manchester, she strongly identifies with her Pakistani heritage, and is committed to encouraging Pakistani girls and women to pursue STEM-focused careers.

'When I participate in workshops and events […] girls from my own community […] come up and ask about these things, my experiences. I especially wear my traditional attire in many of the events - so it gives out a message to Pakistani girls in the UK about balancing traditional and professional roles'.

Mumtaz has indicated she firmly believes that teachers and especially parents are a critical factor in career aspirations and ambitions of children, especially girls. As such, she considers their education to be crucially important to the success of Pakistani women in STEM.

As a motivational speaker and trainer, she is very passionate about women's participation in education, and strongly believes that sharing the best practices and lessons learned of different countries is crucial to increasing female participation in education and in the workforce.

'I have noticed immense strength of character of Pakistani women and would love to see the names of the successful women who have achieved in the field of science' on the National and International circuit.

With regards to promoting women's engagement with STEM subjects and careers, Mumtaz supports many of the recommendations of this study: female mentorship to share information, expertise, and experiences with aspiring female STEM professionals; educating and informing parents about career options for their daughters; and conducting skills based workshops and seminars for girls. She frequently provides guidance and advice to many female students, who usually approach her through LinkedIn, or during the workshops and speaking engagements.

'I have noticed immense strength of character of Pakistani women and would love to see the names of the successful women who have achieved in the field of science' on the National and International circuit.'

IMPLICATIONS AND RECOMMENDATIONS

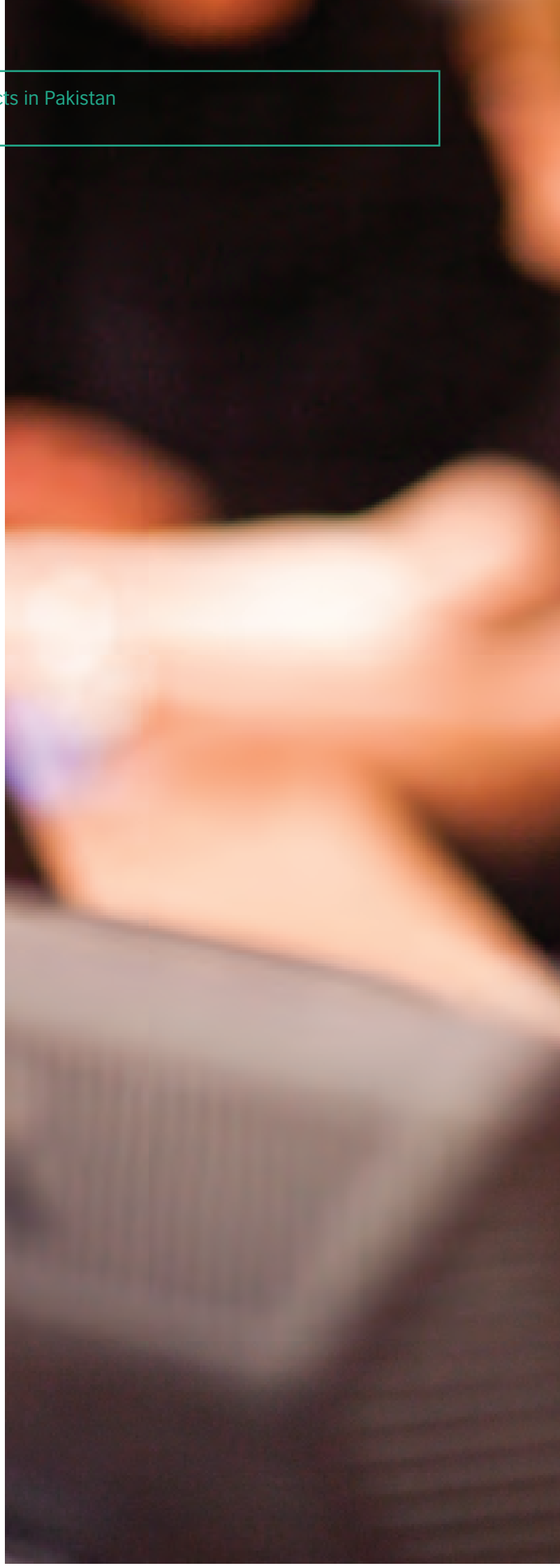
5.

Even in countries where it appears that more significant progress has been made towards gender parity in STEM subjects, it is clear that the perception of STEM subjects is not straight forward. One study sought to link egalitarian attitudes and societies to increased female interest in working in STEM fields by collecting achievement data and qualitative surveys from representative samples of secondary students across Europe. Surprisingly, the authors found that gender-egalitarian attitudes had a negative relationship with girls' interest in working in STEM fields. However, gender equality in the public sphere (i.e. presence/visibility of potential role models) had a positive relationship on women wanting to work in STEM [32]. It is not easy to identify or enact programmes or policies to improve women's representations in STEM fields.

This research has nevertheless allowed us to identify the social and cultural mechanisms that are affecting young women's decision making and the attitudes of those around them. It has also demonstrated an appetite for change and suggested that it is crucial to expose young women to STEM subjects and opportunities early on in their education.

The data demonstrates very complex social trends and powerful cultural norms that it is impossible to expect any one programme or policy to counteract. What is clear, however, is that a multi-pronged approach is required. Offering female only environments for women to study STEM subjects is crucial. However, programmes will be more effective if they target not just the young women but also their families and communities. This is particularly true for programmes targeting young women from public schools. It is also important to include training and information programmes for teachers and career counsellors, to ensure a wider impact.

As part of this study, British Council and Carfax Education have also developed a series of case studies, featuring women in Pakistan who are pursuing careers in STEM. These will be incorporated into future programmes to provide inspiration to young women. Equally, as we launch girls' science clubs, we plan to draw extensively on the qualitative data to ensure that trainers are able to speak to the concerns that young women, their families and communities might have.



CASE STUDY

Role Model 4, Lab Engineer

For reasons of confidentiality, the name and any other identifiable details of the fourth role model have been withheld, however, her achievements are of significant relevance to this study, and could serve as an inspiring example for women wishing to continue their STEM education and careers after marriage and having children in Pakistan.

The fourth role model for this assignment is currently employed as a lab engineer at a university in Islamabad, and anticipates starting work as a Lecturer at the University shortly. The role model is a qualified engineer, having completed both her Bachelor's as well as Master's degrees in Mechatronics, Robotics and Automation Engineering, a challenging field of study, comprising subjects of Mechanical, Electrical and IT Engineering. Although the field of Mechatronics is a relatively new area of specialisation and research, especially within Pakistan, the candidate chose to purse this as her field of specialisation due to her interest in the subject, as well as a resolve to pursue a new and distinctive subject instead of more popular areas.

When asked about her motivations for choosing STEM, she stated she was inspired to pursue engineering because she admired the male members of her family who worked in the area. She was the first female member of her family to graduate in a STEM-focused subject; she faced strong opposition from her extended family during her studies. The novelty of the subject in Pakistan increased her extended family's opposition to her studies, as did her desire to study away from her family home in Islamabad. However, the candidate mentioned that it was due to the support received from her parents that she persevered.

Like most female students in Pakistani engineering classrooms, she had to cope with the challenges of male-dominated classrooms and peer groups, with only 2 female colleagues in her class. Despite initial challenges, however, she ultimately came to rely on friendships with and support of many of her male colleagues to complete her degree.

Even after marriage and children, the role model has continued her studies and work within the field. While the respondent gave much

credit to her spouse (and also parents) for being able to maintain this balance, she nevertheless faced many challenges, not least in securing employment due to employers' scepticism of recently married women.

The candidate mentioned that most of the opposition that she received following her marriage was from her in-laws, who in spite of promises to be supportive of her career prior to marriage, refused to allow her to work once she was married and had children. However, the candidate indicated she was able to overcome such prohibitions with the strong support of her spouse and mother:

It was too challenging, […] so I asked my mother… she guided me that after marriage, for one or two years, if you stay firm and keep on doing your job…[and]…do this in a synchronised way. So I just remained firm for this, [and] that I am not going to leave the job, I have got this opportunity, [so] I am not going to do this, so I remained firm and I even started my Master's degree programme simultaneously.

Like most female students in Pakistani Engineering classrooms, she had to cope with the challenges of male-dominated classrooms and peer groups, with only 2 female colleagues in her class. Despite initial challenges, however, she ultimately came to rely on friendships with and support of many of her male colleagues to complete her degree.

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