BRITISH COUNCIL

Women in STEM in Egypt Case Study

Presented to
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List of Abbreviations

CAPMAS	Central Agency for Public Mobilization and Statistics
ICT	information and Communication Technology
NCW	National Council for Women
STEM	Science, Technology, Engineering and Mathematics

Overview

Pivot Gender equality means that all men and women, boys and girls need to be treated equally and to have the same rights and the same opportunities to succeed in life.

In the past few decades, where a lot has changed around the globe, our commitment towards an inclusive, equitable and sustainable society remains an important priority. Decades of progress have revealed that the global gender gap has narrowed over time, owing to a collaborative global effort in some countries, while other countries still behind.

In general, the British Council implements a twin-track approach to addressing gender:

- Empowering Women and Girls: This includes programmes that have explicit gender equality objectives and provide opportunities for women to increase their skills, confidence, and ability to bring positive change. As part of this, we have created? the Women in science, technology, engineering and mathematics (STEM) research programme.

- Gender mainstreaming: Ensuring that the concerns of both men and women, boys and girls are integrated into every stage of our activities, projects and programmes. Hence ensuring that we:

  - o ‘do no harm’ by considering the potential unintended consequences of reinforcing inequalities

  - o avoid excluding any groups, including women and girls

  - o be as inclusive as possible to ensure that we are engaging with both men and women, boys and girls through our activity

The British Council is committed to playing its part in contributing to the Sustainable Development Goals (SDGs), including the goals and targets on gender equality and the empowerment of women and girls. Creating opportunity for women and girls is set out as a priority in our corporate plan. Working with partners worldwide to progress gender equality is an important way in which we can meet our core purpose of building knowledge and understanding between the UK and other countries.

This report presents evidence about the progress on gender equality in STEM fields in Egypt and identifies areas of improvements that we need to tackle. Our research sample shows that while women are engaging in STEM at the tertiary education level, it is the integration into the labour force which makes it difficult for there to be a more equitable distribution of women across all STEM-related sectors. Egypt has a strong tradition of female empowerment and development but remains patriarchal in many aspects of progress and opportunity; the number of women in STEM education does not translate to those in the work force.

Shaimaa ElBanna
Head of Science

Introduction

Pivot Global Education has been commissioned by the British Council, Egypt to conduct a study on women in science, technology, engineering and mathematics (STEM) in the country to look at women's perception of their engagement and representation in STEM in Egypt. Through face to face interviews and focus groups, online surveys, phone interviews and data gathered from national and international organisations, this report creates a picture of how the women, surveyed and spoken with, are engaged in and contributing to furthering scientific pursuit; as well as what factors have supported or hindered their overall participation. The team focused on capturing the stories of women from different career backgrounds-- all STEM related-- and learning more about their career paths.

Using a case study approach, there is an identifiable selection bias in the women represented on the study (predominately evidenced within the interviews and focus groups) as the large majority of them are from an academic background and have been, in some form or another, engaged with the British Council on other projects. Using a predominately qualitative approach (with quantitative data from our survey responses), the women shared their stories, experiences, hopes and aspirations for future generations of women in STEM. The main themes, as perceived by our participants, relate to opportunities, successes and struggles they have encountered through their path, and what motivates them/encourages them to do STEM.

This research study unpacks and examines the multiple thresholds of women and girls in higher education and employment in STEM fields in Egypt. This research is a timely and important intervention that encompasses a representational and analytical approach to examine the trends, interrogate gaps in the rhetoric, narrative, and data in addition to outlining opportunities—all of which serves as a baseline of the state of engagement of women and girls in STEM in Egypt.

This research aims to provide a general profile, within the historical context as well as through the interviews and survey responses of women currently involved in STEM fields in Egypt (as well as the diaspora), assessing their experiences and influences, highlighting contributions to their fields. The central objective of this research is to support women in STEM professionals, women and scientists working in the field of gender equality.

While the recent history of women in STEM in Egypt is not high profile, their contribution goes back hundreds of years to advancements in medicine, science and technology. The historical background for this report on women in STEM encompasses a more comprehensive outlook on women's access to the public sphere in terms of education and political participation. The study looks at women in STEM fields within Egypt and the diaspora and how they became engaged in their fields, their current situations and their perceptions of the future of STEM education and careers in Egypt.

Egypt has made significant progress in gender issues, such as political participation and educational attainment. Egyptian women throughout history have excelled and been pioneers in different fields including STEM. While there have been several milestones for Egyptian women in STEM in terms of educational attainment, there are still various obstacles for women to access and thrive in certain areas within the labour market in STEM fields. The literature reviewed for this study on women in STEM focuses on a representational approach, providing statistics. Literature, and particularly analytical literature, available around women in STEM in Egypt is limited; it is often tackled within the scope of women's employment, women's economic empowerment, or education. Furthermore, studies addressing women in the labour market within various sectors, or women's economic empowerment, occasionally refer to some STEM fields like ICT. However, there is hardly any research that provides an in-depth analytical view on the status of women in STEM in the context of Egypt. Hence, the integrated desk review shows a need for an in-depth study that provides a piece of primary data research, creating a statistical overview on women in STEM along with an analysis that interrogates the root causes.

The existing data highlight significant progress in educational attainment in STEM, yet such figures do not translate into the labour market (outside research and management level in academia). Literature suggests that structural challenges, often represented in gender stereotypes and social dynamics, contribute significantly to such a gap. However, the literature outlines support systems and opportunities to overcome such disparity, including the National Council for Women's (NCW) National Strategy for the Empowerment of Egyptian Women 2030, development of legal policies as well as several other efforts on the ground.

Lack of women in STEM in the wider labour market has not dampened the hope and aspirations of those currently engaged. Those interviewed see a bright future for those who are at the start of their journey and those who have yet to begin. There is, however, a need to bring more women role models to the forefront so that girls and young women get the message that they have options and can pursue science as a viable career. Furthermore, the challenge is not merely increasing numbers of women in STEM in Egypt but instating measures, programmes and policies that sustain their participation and advancement to increase visibility and opportunity in the wider labour market.

Methodology

The primary data analysis for this study of women in STEM was based largely on a number of academics and students (both within Egypt and the diaspora) who were recruited through the British Council, because of their current, or past engagement with the activities of this organisation. The findings of this report are supported by a critical evaluation of secondary desk research of the literature available in Arabic and English as well as data analysis.

The study draws on a range of academic literature combined with various other source material; including, but not limited to official state reports, international organisations' studies and reports, news reports, NGOs' reports, state-commissioned studies, as well as existing legal texts in the penal code. However, it must be noted that the findings are not fully comprehensive due to the inaccessibility of national statistics on women studying or working in STEM subjects. This absence of data on numbers of women engaged in STEM roles across the country has limited what has been presented in this report, and the conclusions and recommendations reflect the sample data collected.

A mixed methods approach (quantitative and qualitative) was employed to assess levels of engagement and experiential learning of participants. This provided the team with the ability to map, on a widespread scale, levels of engagement and output. The use of mixed methods allows information to be analysed in multiple ways. Our research has focused on understanding what are the relevant factors that have supported women engaged in STEM and also examine what might be preventing more women from pursuing this path.

Twenty-two participants were interviewed face to face, in small focus groups or through online meeting platforms. These interviews provided more qualitative context and insight around the experiences of females working and studying in the area of STEM. In addition to this, an online survey was widely distributed through various network channels. The questions were divided into the following categories: students— those still in tertiary education (studying at the bachelor's degree level and above) and career professionals. This allowed for data to be viewed through the lens of those who were still moving along their career trajectory and those who had been engaged in their careers in STEM for some time. Of the 63 eligible survey responses, 32 were STEM students while 31 were employed in an area of STEM.

Sampling Issues

In the interest of time, the cohort of women interviewed were selected by the British Council for their engagement in a number of their programmes. The majority of the students interviewed were on an academic scholarship/fellowship (facilitated by the British Council) overseas. This introduces a convenience sampling issue (or bias) which affects the method in which the data is reported. The use of a case study approach allows for results to be presented but it does stress that they are not conclusive or fully comprehensive, but representative of the sample provided.

Overview of the Historical Involvement of Women in STEM

The ancient and historical involvement of Egyptian women in STEM fields is well documented. While the continual development of education and opportunities has shaped the increased number of current female representation in STEM fields, very few modern women come to the forefront. With most ancient and historical Arabic literature, the focus often refers to the notability of women; few provide a critical examination of the status of women during those periods.

Egyptian women's contribution and presence in STEM fields can be traced to the times of the Pharaohs. In ancient Egypt, records do not only show that women enrolled in science education but that there were around 100 female pioneers in the STEM domain. A prominent female doctor at that time is Merit Ptah, the first-ever named female doctor as well as the first woman in the pharmaceutical field. Another significant figure of Ancient Egyptian women in science is a doctor named Cleopatra, who was an expert in the field of obstetrics and gynaecology, whose work on pregnancy, labour, and women's well-being were studied for more than a century after. Another female

pioneer is the one of Tapputi-Belatikallim around 1200 B.C, who worked with chemicals utilised for making perfumes.[1]

In the last centuries, the literature traces the inclusion of women in the public sphere, started simultaneously with the establishment of Modern Egypt. In many cases, it was restricted to care services, echoing gender dynamics within the culture. The first school for women's education was established in 1832 for the education of midwives. Subsequently, after championing by various advocates, the first comprehensive school for girls' education was established in 1873 to include 286 girls after its inauguration. Girls' education continued to expand through the building of more schools to include 44,319 girls enrolled in education by 1945. [2]

The promotion of girls' education was not a singular nor random act, it came at time of increased mobilisation around women's issues in the late 19th and early 20th century. The literature traces the history of women's and feminist movements within Egypt and the Middle East and North African region. [3] The women's movement, which did not only showcase women's presence in the public sphere, promoted and pushed for women's rights in the public sphere from higher education to political participation. From Safiya Zaghloul, an Egyptian political activist on the forefront of protests in 1919 to Huda Shaarawi, one of Egypt's most prominent women's rights activists and founder of the Egyptian Feminist Union in 1923, the presence of women was strengthened overall.

The involvement of Egyptian women in STEM in higher education can be traced back specifically to 1930 when 13 women joined Cairo University for their undergraduate studies; eight of whom joined the Faculty of Medicine. [4] Thereafter, women continued to enrol and expand into fields such as engineering and pharmacy. During this period, Latifa Elnady, the first female pilot, and Kawkab Hefny Nassef, the first female surgeon, as well as the first female physician to join the syndicate of medical doctors, completed their degrees.[5] Similarly, Helena Cedarros, the first Egyptian doctor. She was born in Tanta in Gharbia Governorate in 1904. After her elementary education, she enrolled in the internal department of the Sunni School for Girls in Cairo and then at the Teachers Training College. In 1922, at the end of the second year, she was sent on a mission to London to specialise in mathematics. She and Zeinab Kamel Hassan are among the first Egyptian women to study in England. She attended London Medical School to study medicine with five other Egyptians. She became a qualified doctor in 1930 and returned to Egypt to work in the Kitchener Hospital and to become the first Egyptian doctor. In addition, there was Sameera Moussa, known as the first female Egyptian nuclear scientist. Dr Moussa graduated in 1939 with a bachelor of science in radiology from Cairo University and went on to receive a PhD degree in atomic radiation, becoming the first woman to do so, in addition to being the first to hold a teaching staff post. Meanwhile, with the industrial revolution of the 1930s, women's presence was also evident in the country's factories.

This change paved the way for women's representation in the public sphere overall; where several women from that period have become pioneers and consequently role models in Egypt's history and schoolbooks. In the 1950s there was further promotion of women's rights and access to the public sphere, which in turn, certainly reflected

on women's participation in STEM fields. Egyptian women were granted the right to vote as part of wider political rights in 1957. The first female minister, Hikmat Abu Zayd, was appointed in 1962 as minister of social affairs.

During this time, Egypt's President Gamal Abdel-Nasser launched several industrialisation programmes, such as the nationalisation of industries andthe creation of state-run consumer cooperatives. President Abdel-Nasser aimed to capitalise on women, considering them underutilised labour, instating that as a state policy. This

1 Khalil, R. Moustafa, A. Moftah, M. & Karim, A. (2017). How Knowledge of Ancient Egyptian Women Can Influence Today's Gender Role: Does History Matter in Gender Psychology?. Frontiers in Psychology.
2 Women and The Revolutionary Movement Study. (2015). Human Rights Documentary Organization (HRDO). Cairo. p. 9. Available at: https://hrdoegypt.org/wp-content/uploads/2015/03/Women-and-Revolutionary-Movement.pdf
3 Al-Ali, N. (2000). Secularism, Gender and the State in the Middle East: The Egyptian Women's Movement. Cambridge: Cambridge University Press.
4 Women and The Revolutionary Movement Study. (2015)
5 Abdulaal, M. (2018, October). Egyptian Women in the Workforce: Then and Now. Egyptian Streets. Available at: https://egyptians-treets.com/2018/10/16/an-evolution-of-the-working-egyptian-woman/

took place during the late 1950s, marked with the 1956 constitutional policy officially recognising women as equal citizens with the rights and responsibilities to work alongside men in building the nation. Legislative and administrative measures removed gender as a basis for discrimination in employment and wages.[6]

Additional legislation was enacted to make sure working women's roles would not collide with women's roles and responsibilities as mothers and wives in order to "protect womanhood". This still put the emphasis on the fact that a woman's main responsibilities are to her household duties which should be valued more than any external work responsibilities. This piece of legislature meant that women were not allowed to work during certain hours; leaving them with roles in fields such as care and administrative work that would not require long hours.

The nationalisation and industrialisation processes translated into the expansion of sectors, such as free universal compulsory elementary education, free higher education, as well as the comprehensive access to healthcare. This in turn instigated a need, as well as an opportunity, for women to become doctors, nurses, pharmacists, and lab technicians in addition to teachers, statisticians or social researchers. This pivotal point in the 1950s increased women's participation and engagement in the public sphere in Egypt —led by proactive state policies and decades of women's suffrage— and saw an increase in women holding leadership posts in the cabinet, educational sectors, and other fields. This period, it can be argued, paved the way for women's presence in STEM fields today, whether in higher education or employment.

6 Bier, L. (2011). Revolutionary Womanhood: Feminisms, Modernity, and the State in Nasser's Egypt. Cairo: The American University in Cairo Press.

Overview of current situation of Egyptian women in STEM

In 2019, the Central Agency for Public Mobilization and Statistics (CAPMAS) reported that women constitute 47.6% of the population.[7] The World Economic Forum's Global Gender Gap Index 2020 (a country centred measure of gender equality) ranks Egypt 134 out of 153 countries[8]. The report offers an effective means to benchmark contextual gender disparities between women and men within the four main fields of education, politics, economy, and health, to determine whether there is equity in the positions women hold in these sectors, as compared to men. The report indicates that the current disparity nationally between women and men stands at 37.1%. In terms of female education, Egypt ranks 102 overall and 140 in terms

of economic opportunity and participation in the workforce for the public and private sector; further highlighting the gap between educational levels and the labour market.

The issue of women in STEM can be looked at in one of two ways: firstly; educational attainment and secondly; the labour market and employment in STEM fields. There are several local and international studies that tackle the issues of representation, examining the progress accomplished in education and labour. Nonetheless, only a few studies interrogate the causes behind such numbers. This leads to a lack of analytical data that interrogates the status of women in STEM in Egypt beyond pure numbers. The quantitative and qualitative data gathered for this report only show a small sampling of the total number of women engaged in STEM, all of whom have progressed from strong educational backgrounds. They acknowledge that much of this was due to familial support and drive stressing the importance of further and higher education.

Female Educational Attainment

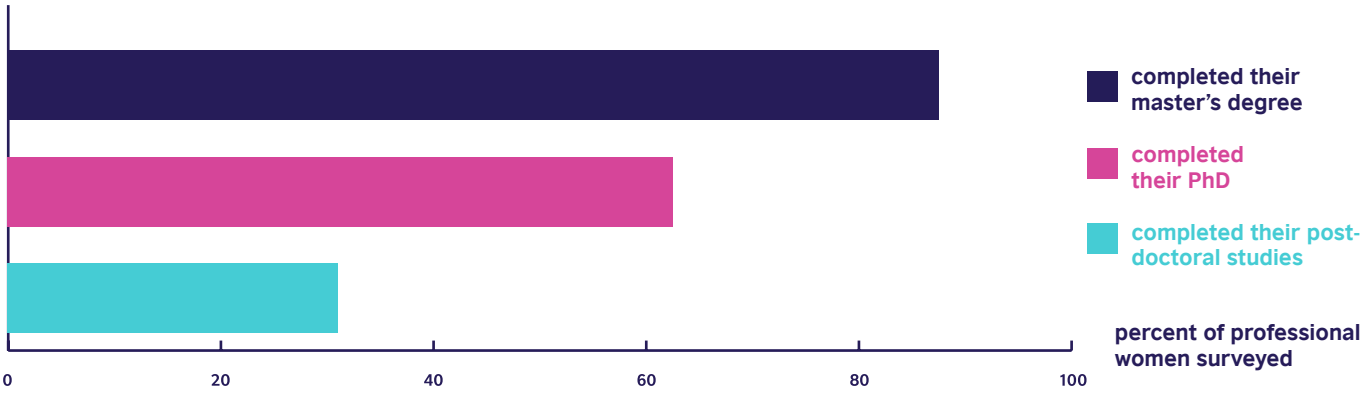
CAPMAS reported that, in 2014/2015, females accounted for 51% of students in public and private universities[9]. Of this number, female students in public universities accounted for 56% (262,000 students) of undergraduates in 2015. More notably, women made up 48% of the total number of graduates in STEM subjects that same year. CAPMAS also reported that in 2014, women constituted 48% of graduates with a master's degree and 39% of those who received a doctorate.

The engagement of women in STEM in Egypt – at least within academia — is quite high. The academic system in Egypt is such that those with the highest marks in secondary school are strongly encouraged by their parents, family members, and teachers to go into the sciences; medicine being the preferred choice, followed by engineering and life sciences.

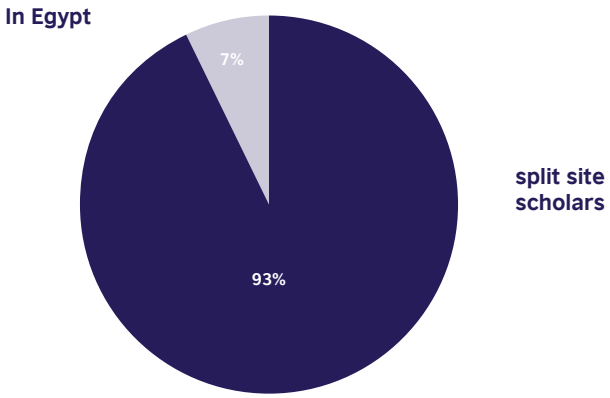
7 CAPMAS. (2019). Statistical Abstract. Available at: https://www.capmas.gov.eg/Pages/StaticPages.aspx?page_id=7193
8 World Economic Forum. (2019, December) Global Gender Gap Report 2020. Available at: http://www3.weforum.org/docs/WEF_GGGR_2020.pdf
9 World Bank. (2018, May). Study on Women's Economic Empowerment. Available at: http://ncw.gov.eg/wp-content/uploads/2019/03/economic-empowerment-ar.pdf

In our study, each of the women surveyed online had completed their undergraduate degree in Egypt, with the exception of one who completed her degree in both Egypt and Syria. 84% of professional women surveyed completed their master's degree (all but one) solely in Egypt; 77% had completed a PhD (75% of those in Egypt, 12.5% as split site scholars, 12.5% as international students outside the Middle East and North Africa). Additionally, 39% of the professionals surveyed had completed their post-doctoral studies (44% completed within Egypt and as split site scholars and 11% as international students).

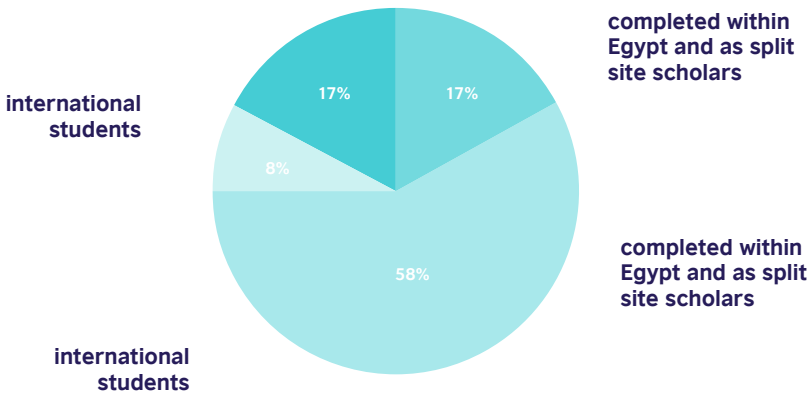
Female Professionals Education Survey



Master's degree completion site

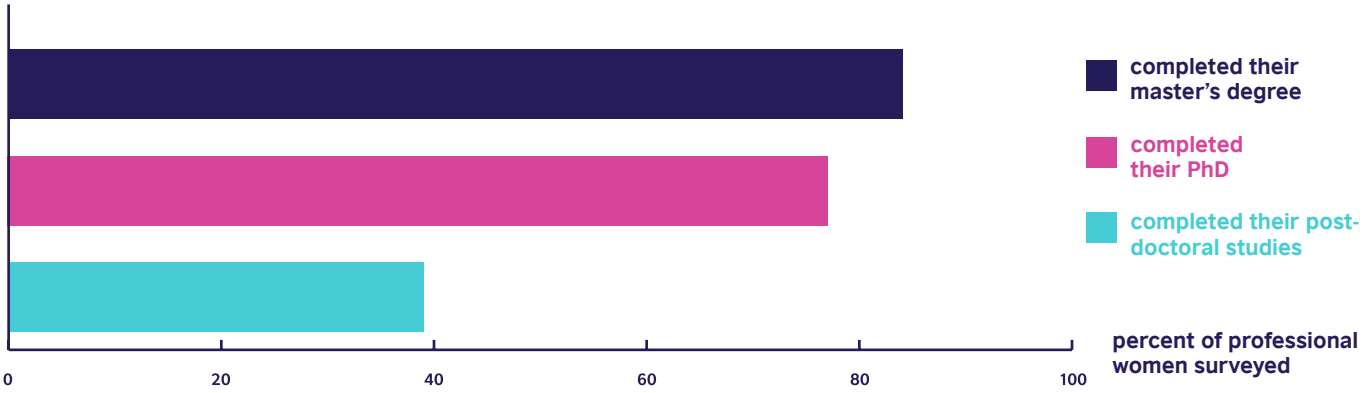


Post-doctoral studies completion site of Professionals surveyed

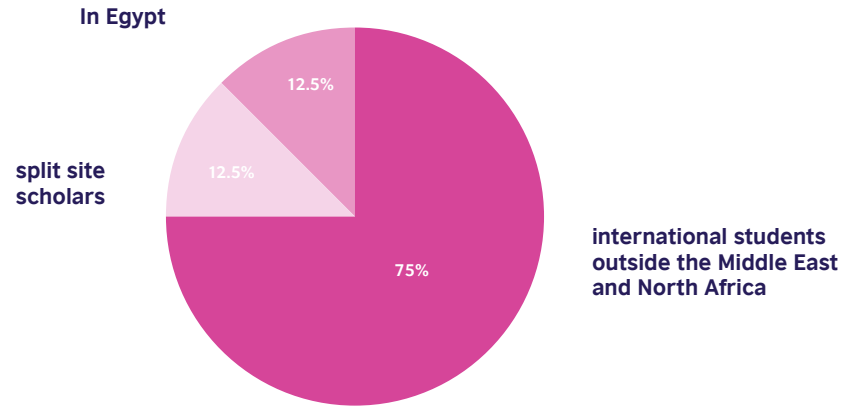


87.5% of students surveyed had completed a master's degree (93% in Egypt, the rest as split site scholars); 62.5% of students surveyed had completed their PhD studies, with one student currently progressing with hers, while 31% of students surveyed had completed their post-doctoral studies (17% as international students, 58% completed in country, 8% as a split site scholar and 17% are in the process of completing).

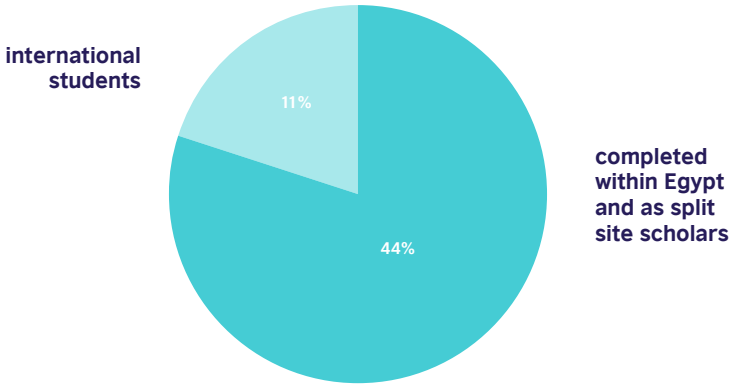
Female Students Education Survey



PhD degree completion site of Professionals surveyed



Post-doctoral studies completion site of Professionals surveyed



In terms of STEM disciplines, survey responses varied. The most popular area of STEM for students was in the life sciences (biology, zoology, veterinary, biochemistry and biotechnology, botany) followed by health sciences (medicine, pharmacology, radiology, neuroscience). Other fields included physics and mathematics, chemistry, engineering, general science, and others (such as architecture and STEM education).

The results from the professional women surveyed, found the top areas of STEM inversed, i.e. more of them reported working in health sciences than the life science, with engineering and chemistry not far behind and general science education, physics, and mathematics having least representation in our sample.

Labour Market

The Global Gender Gap Index 2019 asserted that in the Egyptian labour market only 24.7% of women are currently part of the workforce, of which about 20% are on part-time contracts. Women's unemployment rate is 18.9% compared to 5.7% for men, according to a CAPMAS report on the labour force published in November 2019.[10] According to the global gender index, Egypt ranks 143 in terms of women's participation in the labour force.

Women graduating with a STEM degree represent 35.3% of scientific professionals, according to the CAPMAS 2017 bulletin of employment, wages, and working hours. In addition, the study surveyed the economic activities of 25 establishments, highlighting that 26% of women are engaged in professional scientific and technical activities (as of June 2017). According to the same report, female specialists in the fields of natural sciences, mathematics and engineering sciences working full time are only 18.44% of the public sector workforce. The number of working hours varies considerably from the public to the private sector; the average number of working hours per week in the public sector was 47 (from 5 institutions surveyed), compared to 52 hours per week in the private sector (from the 20 organisations surveyed). This could go some way to explaining the statistic that women working in STEM fields prefer to do so in the public sector (21%) over the private sector

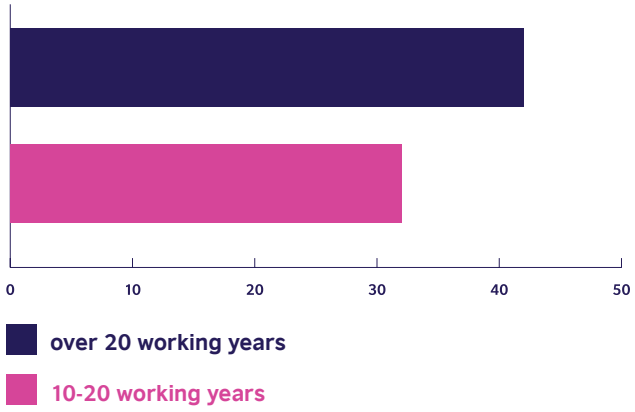
10 CAPMAS. (2019, May). Labor Force Report. Cairo. Available at: https://www.capmas.gov.eg/Pages/Publications.aspx?page_id=5106&Year=16603

(11%), however the numbers change depending on the specific field.[11]

This aligns with a common theme found across the interviews, related to some of the social pressures that women face while trying to join the workforce. For example, interviewees expressed that there is still pressure to choose between family and career and this is even more prevalent in the rural areas, often citing how women can struggle to get support from their families, partners, colleagues, and friends to pursue their careers. On the other end, they are expected to work very long hours in order to be able to progress in their careers, explaining that the expectations for women were often unrealistic due to other responsibilities and there was little equity for career progression. While women in early career positions considered this a significant issue, women in more established positions expressed that they did not see this as a gender issue, but did express that they had sacrificed a lot of their family life and time with their children in order to put the hours in at work to achieve career progression. Among the women interviewed, 18% mentioned that because they chose their career, they had sacrificed having a family all together, finding it difficult to find supportive partners or simply lacking the time to find a partner. Therefore, those interviewed stated that many other women choose not to continue their career after graduating from college, choosing instead family life or working in other areas where they could manage their work-life balance in order to be more present in their family life.

This is not to say that there are not women who have been working in STEM for a prolonged period of time. Of the professional women surveyed, 42% had worked in their current field for more than 10 but less than 20 years, and 32% had over 20 years of work experience in their STEM field. Female students surveyed said that at least 63% of them had teaching responsibilities within their current studies; with 43% stating that they spend an average of half their time on teaching responsibilities— contributing to the overall number of women working in STEM.

Female Work in STEM Field



Female Students Teaching Survey

According to the UNESCO Institute for Statistics (2018), there is an estimated 44% of women engaged in scientific research in Egypt. [12]In an earlier UNESCO report (2013) it estimated that 41% of women are in the field of natural sciences, 18% are in the field of engineering and technology, 46% in the field of medical science, and 28% are in the field of agricultural science. [13]

Moreover, in a press statement in November 2018, Dr Mahmoud Sakr, the president of Egypt's Academy for Scientific Research and Technology (ASRT)— the state institution responsible for scientific research— revealed that while women make up 54% of researchers in research centres, only 15% of women received state awards and only 13% registered patents. [14] These numbers may indicate that while women are well represented in higher education and

11 CAPMAS. (2018). Annual Bulletin of employment, wages and working hours statistics 2017. Cairo. Available at: https://www.capmas.gov.eg/Pages/Publications.aspx?page_id=5104&YearID=23462

12 UNESCO Institute for Statistics. (2018, June). Women in Science. Available at: http://uis.unesco.org/sites/default/files/documents/fs51-women-in-science-2018-en.pdf

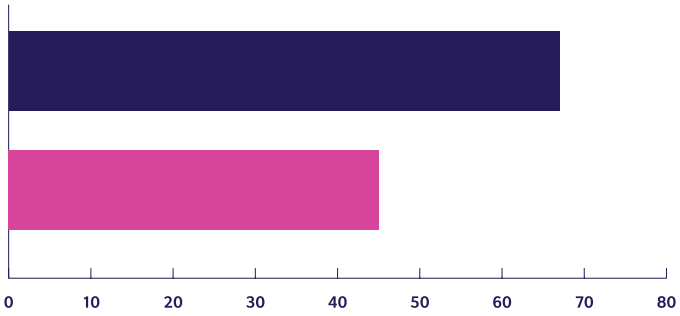
13 Huyer, S. (2015). Is the gender gap narrowing in science and engineering?. Published by UNESCO.

14 ASRT. (2018). President of the Academy of Scientific Research and Technology : Women represent 53.8% in scientific research. Available at: http://www.asrt.sci.eg/ar/index.php/news/item/544-asrt-women?TSPD_101_R0=fafc7c2814efcd5d4f4bb-25f5a135392bsa0000000000000001de012dc5ffff0000000000000000000000000005e499461006c6c30dc

research in science, they are not equal recipients of government incentives; either because they do not apply, or they are not nominated. This highlights the importance of examining equality beyond increasing women's participation in STEM to foster their progress in the field.

The large majority of the professional women in our survey and interviews (58%) worked primarily as lecturers and professors, while less than 10% identified as working in industry or as researchers. Of the professional women surveyed, 55% claimed to be in leadership positions. However, both in the survey and during the interviews it was mentioned that more senior administrative positions are heavily dominated by male colleagues. In terms of visibility, 67% of student survey respondents reported that more than half of their counterparts in their field of study were female, while only 45% of professional women surveyed responded the same, meaning that representation of women in STEM fields is larger at the student level than in the workforce, which supports what was found in the literature review.

Female Representation in STEM Fields



students reported that more than half of their counterparts in their field were female

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In the interviews it was often mentioned that medicine, engineering, and research are very competitive fields and it is particularly hard to find jobs and secure a permanent position in research institutes. This means that the most viable career path for women is often academia, which is reflected in part by our data sample. But even within academia, depending on your area of expertise and the type of institute, it can still be hard to find permanent and well-paid positions. Data from the interviews also revealed that in academia, representation of women within departments changed considerably; some fields such as biochemistry have a large representation of women, while others such as electrical engineering have very little representation.

However, it was often cited that higher academic management and administrative positions were dominated by men. While this fact in particular might not be pushing women away, some of the responses indicated that working environments in which men were the majority could often be not welcoming; the expectations of working hours were longer, and promotions were also harder to achieve. This is not to say that one is a direct consequence of the other, and the interviewees definitely did not express causality, but they felt that male colleagues might not understand women needing to balance family and career.

Analysis of survey data supports findings in the literature review, that while progress has been made at the educational attainment level, gender disparity remains an issue in the labour market overall and particularly in STEM fields for women. In summary, both survey and literature review demonstrate a further gap between the percentage of female graduates in STEM and working women in the technical STEM fields. This gap is significantly lower between the percentage of female graduates and female researchers in STEM.

These findings highlight the importance of examining the mentorship of women in STEM and suggest the importance of further evaluation of the systems and structures that exist to provide support for women, not merely to join STEM fields but to advance in research and climb the professional ladder. This is particularly evident when it comes to the difference between private and public sector work conditions. Furthermore, there is a lack of studies around geographical location and economic class and the role they play in women's participation in STEM.

Efforts to support women's participation in STEM

Since the 1990s, there has been an increased focus, by the state, private companies and development agencies, on promoting women in STEM, leading to an array of programmes, awards and incentives. Earlier work tackled several thresholds on supporting women in science, from direct support to girls and women's education to promoting women's inclusion in technical fields most significantly in ICT. A milestone that highlights earlier work around women in STEM is the first Egyptian and Arab woman to win, in 2002,

the L'Oreal UNESCO Prize for Women in Science, which was launched in 1998. This is Dr Nagua Abdel Meguid, professor of human genetics, who is included later in this study as a role model for women in STEM fields. Another notable early example is the work of Egypt's Ministry of Communication and Information Technology since the 2000s on women's inclusion in science, such as its project on Integrated ICT for Development in Siwa Oasis, launched in 2004, that promoted learning about and usage of ICT tools in MSMEs as part of a larger sustainable development programme for marginalised women. [15]

More recently, there has been a great deal of work done on education, with particular efforts around STEM for girls in primary and secondary education, as well as increasingly significant efforts, and actors, that tailor and promote higher education and employment for females in STEM.

The Academy of Scientific Research and Technology (ASRT), the Egyptian body responsible for national scientific research, is among the chief stakeholders as it has worked on promoting women in STEM through several initiatives. In its mandate, the ASRT states that it aims to 'empower young men and women" in science by working on numerous projects and initiatives such as "Scientists for the next generation, Egyptian Young Academy of Sciences, National Committee of Women, My Project, My Future". [16] ASRT's support also extended to hosting the first International Conference on Women in Science Without Borders in 2017. [17]

The ASRT also manages and directs various state awards directed at women which reward personal scientific efforts and the pursuit of scientific progress. Awards include the Nile Awards, State Merit Awards, State Awards of Excellence all given for achievement in the fields of science and advanced technological sciences as well as the State Encouragement Awards that encompass specialisations in the fields of basic sciences, from agricultural sciences, medical science, to engineering science, and advanced technological sciences. [18]

Other initiatives supporting the inclusion of women in STEM include the Egyptian National Commission for Education, Science and Culture (EGNATCOM)'s, 2019 work with UN Women and UNESCO to increase the information and data available on Wikipedia in Arabic of women in STEM fields.[19]

All the women from the interviews completed their undergraduate studies in Egypt, mostly in public universities, but all of them had spent some of their postgraduate studies abroad, either as part of their PhD, or as interns and/or fellows after their PhD. It is important to mention, that all of the interviewees secured funding to complete their PhD studies, albeit through different schemes. Some of the women completing their PhDs abroad secured funding through the international institutions they were attending - accepted into the programme with a scholarship. A significant number of them secured funding through Egyptian government initiatives. For example, they had graduated from their undergraduate degree with top marks, which secured them a position in the university as teaching assistant - secured employment - and they could then continue their master's and PhD studies with funding support from various Egyptian universities. Some of them started their PhDs in that scheme and completed it at an institution abroad thanks to grants, often offered in collaboration with the government and private or international agencies. Those who completed their PhDs in Egypt later found different funding opportunities to go abroad and complete postdoctoral practical internships or research fellowships. They mentioned that the large majority of these funding schemes are not necessarily targeted at women, but women are definitely encouraged to apply. In some cases, the women received direct funding from government agencies, national research centres, or in collaboration with industry through calls on specific research projects that they were interested in funding. Among some of the most important funding schemes that were mentioned often during the interviews were Fulbright, USAID, Erasmus, different schemes at the British Council, and some private companies such

15 Integrated ICT for Development. (n.d). Available at: http://www.ictfund.org.eg/page/225_%D9%90

16 ASRT. (n.d). About us. Available at: http://www.asrt.sci.eg/index.php/about

17 Francescon, D. (2017, June). Empowering female scientists in Egypt and beyond. Available at: https://www.elsevier.com/connect/empowering-female-scientists-in-egypt-and-beyond

18 ASRT. (n.d).Prizes and Fellowships. Available at: http://www.asrt.sci.eg/index.php/state-prizes?TSPD_101_R0=a0c53e90f925db11c34113c869901ce4a06000000000000000001dd8eee29ffff0000000000000000000000000000005e54244500662cc746

19 UN Women in Egypt. (2019, March). UN Women, UNESCO and EGNATCOM Join Forces to Shrink the Online Knowledge Gap on Women in Science and Technology. Available at: https://egypt.unwomen.org/en/news-and-events/stories/2019/03/un-women-unesco-and-egnatcom-shrink-the-online-knowledge-gap-on-women

as L'Oréal and Schlumberger. While quantifying the impact government initiatives have had in promoting women in STEM is out of the scope of this study, the fact is that a large majority of the women in our sample have been beneficiaries of these initiatives, a good indicator that such programmes can help in bridging the gap on women's representation in STEM.

In addition to this, there are several development programmes working on enhancing women's involvement in STEM subjects. Most notably, the USAID-funded Higher Education Initiative (HEI), launched in 2014, which focuses on STEM education.[20] One of its main components was advancing girls' access to STEM education, through a $25 million STEM-focused schools project, which ran from 2012 to 2017. In collaboration with the Egyptian Ministry of Education, USAID launched the first school in the Cairo neighbourhood of Maadi. [21] There is ongoing cooperation between Egyptian ministries and development partners around girls in STEM in secondary education, but not higher education.

During the interviews, some of the responses indicated that there are two main problems with STEM education in schools. The first issue is related to the disparity in the quantity and quality of science children are exposed to in the rural vs. urban areas. In particular, they referred to the contextualisation of the education; the interviewees believe that many students in rural areas do not connect with STEM subjects because they do not see the relevance to their personal lives, they are too far removed from the reality of their lives, and there are no tangible role models that they can aspire to follow. Children in rural areas get less exposure to STEM and therefore have less understanding of what to pursue as careers in those areas. Some women explained that they believe the only options are being a lawyer or a doctor, which are both very hard professions to enter; they do not have "local" role models that they can aspire to be; and they would more often than not have to travel to the city or abroad in order to pursue their career. Often their families do not allow them to move away from home unless they are married and depend on a supportive husband in order to do so. The second issue is on a broader scale, namely teaching environments at all levels of education and across the country. In this case they often mentioned that teaching practices were traditional – lecture based, not interactive – which was demotivating for some, finding the subjects uninteresting and therefore discouraging more women to join STEM fields. A couple of the interviewees from the medical field discussed how they were more interested and excited about classes when they were introduced to project based and problem-solving strategies in their field. Another interviewee explained how different education abroad was compared to Egypt, in which she experienced more play and prompting in her school experience abroad and found it difficult to adapt when she came back.

Another example is the ProGirls (Professional Orientation of Girls) initiative, which works to encourage girls in high school to explore STEM subjects and aims to cultivate leadership. The programme runs in stages and has trained 190 Egyptian students from 12 different governorates in Sohag, Damanhour, Alexandria and Cairo, giving them the opportunity to work with 90 female mentors and meet supervisors from 45 local private companies as well as complete internships.

Vodafone has launched a number of initiatives and programmes to support girls (14- 18 years old) and women in the ICT field in Egypt and around the world. In 2019, Vodafone Egypt collaborated with the Ministry of Communications and Information Technology and Microsoft Egypt awarding the participating girls in Hack4Girls programme, for girls specializing in the field of programming, databases and information technology.[22]

One of the most prestigious programmes available to women in STEM is the L'Oréal-UNESCO Women in Science Egypt fellowships, which aims to advance young women in the STEM field by rewarding young female scientists. The programme honours three talented young Egyptian women researchers for the quality of their works, supporting and encouraging them to pursue brilliant careers in science. [23]

20 Schaefer, G. (n.d). Bridging the Gap for Women in STEM and Business in Egypt. Available at: https://www.iie.org/en/Learn/Blog/2018/04/2018-April-17-Bridging-the-Gap-for-Women-in-STEM-and-Business-in-Egypt
21 Council on Foreign Relations. (2016). Why STEM needs girls. Available at: https://www.cfr.org/blog/why-stem-needs-girls
22 Vodafone Egypt. (2019, August). Vodafone sponsors Hack4Girlz program to empower women in technology. Available: https://web.vodafone.com.eg/en/2019-news
23 L'Oreal – UNESCO for Women in Science Egypt National fellowships 2019. (2019, February). Available at: http://www.unic-eg.org/eng/?p=29443

Role Models

While there are a great number of women in STEM, they (and the accomplishments) lack wider visibility. The National Council for Women's (NCW) website highlights a few eminent Egyptian women with notable accomplishments, referred to in a section called "women who made history". Here they feature scientists such as Dr Mona Mostafa, founder of the first breast cancer biology lab in Egypt at Cairo University; Suzan Khalif, PhD. director of the National Institute of Oceanography and Fisheries; and Dr Rana El Kaliouby, a pioneer in Artificial Intelligence, the co-founder and CEO of Affectiva, an AI startup, and a recipient of the Forbes award of America's Top 50 Women in Tech as well as a having been included on Fortune 500's list of 40 under 40.

In addition to these women in STEM is Dr Nagua Abdel Meguid, professor of human genetics. Dr Abdel Meguid was the first Arab laureate to be awarded the L'Oreal UNESCO Prize for Women in Science in 2002. She was also awarded the National Award for Scientific Excellence in 2009 and the National Research Centre Appreciation Prize in Medical Sciences in 2011 for her research on genetic mutations, namely trisomy, down syndrome, autism, as well as treatment of genetic disorders in children.

When asked about role models, the large majority of the interviewees referred to their parents or a relative (41% of the interviewees namely their mothers) as their main role model.

Hmm, my mother a medical doctor. She was bringing up her daughter... and I wanted to be like her. I looked up. I wanted to be successful to be in the medical [field]... since I was little. I was looking to her so she was my role model.

Interviewee

Equally, many women responded that they found role models in STEM on their academic path; many of whom became mentors and in many cases were another woman.

Yeah, I have one of my professors that was a very good role model for me. She is combining many things to get where she is. She is a good mother. She is both accredited and faculty in our program so she is in a very high position. She is clever than she shows. She is doing many things, so she was like a role model for me. I wanted to be like her.

Interviewee

Some of them explained that in order to be effective role models, they need to be relatable, i.e. younger generations need to be able to connect with that person, see that their background is similar to theirs and therefore those achievements are more tangible. They also reflect on the importance of having more role models for younger generations, and for those reasons many of them feel a responsibility to become role models themselves, looking for opportunities to do public facing activities and connecting to their communities. Twenty-seven percent of interviewees also expressed that there are more women visible in government (and some in leadership positions) which needs to be highlighted more as a tool for attracting more early career women to push forward in their path.

While being a pioneer and a first is a significant accomplishment, it is also important to include the work of these women in leadership, advancing to gender equality in the field as well as work accomplishments. Female representation may result in drawbacks if does not yield change or progress.

Challenges & Opportunities

The data presented within this report highlights that, while there has been an improvement in female education in STEM subjects, there remain major hindrances to their involvement in the labour market: the conditions of the labour market, mainly because of long and inflexible working hours, poor conditions for family and parental leave, and gender disparity environments deter women from pursuing careers inSTEM. In addition, there is an issue of not merely entering the STEM field, but maintaining women's participation in STEM employment.

Urban vs Rural

Data from the interviews reveals that there is a larger gender disparity in female education and employment in rural versus urban areas. In part, this is due to cultural issues. For example, women cited that families in rural areas have more conservative ideas about the role of women in society and therefore women in rural areas feel more pressure to stay at home and choose family over career. But more pressing is the unequal access to opportunities and resources between regions. In particular, they brought up that there are less opportunities, in terms of financial support, the variety of career options and work opportunities. Interviewees mentioned that women in rural areas often have to travel long distances on a daily basis in order to attend classes, live in affordable housing (or staying at home with parents), and have a job and in many cases that was not a possibility for them because families would not allow it. Furthermore, these women felt that there is more gender bias and unspoken discrimination in institutes in rural areas, commenting how it can be more difficult to get a position or a promotion, and the existence of unfriendly working environments; often colleagues not wanting to collaborate and therefore not helping them feel a sense of belonging.

Hence, it is important to take into account the specific experiences and hindrances faced by rural women. This raises an essential matter of adopting an intersectional approach to women in STEM with regards to location as well as wealth accumulation and economic class. This reflects on the household and in that process translates into the financial burden of education and female dropout and illiteracy.

Legal Policies

Women's employment is largely governed by policies and legal frameworks that can aid or hinder their work, such as childrearing and maternity leave as well as legal structures that largely dictate the laws around gender.

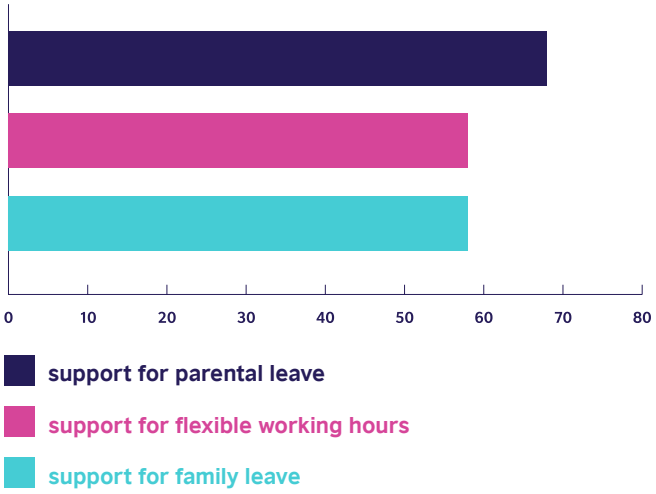
The Egyptian Constitution guarantees equality

between women and men with Article 9 affirming the state's commitment to equal opportunities for all. More notably, Article 11 of the Egyptian Constitution of 2014 stipulates that "the State shall ensure the achievement of equality between women and men in all civil, political, economic, social, and cultural rights in accordance with the provisions of this Constitution". Additionally, it affirms "the State shall protect women against all forms of violence and ensure enabling women to strike a balance between family duties and work requirements and the State shall provide care to, and protection of motherhood and childhood, female heads of families, and elderly and neediest women".

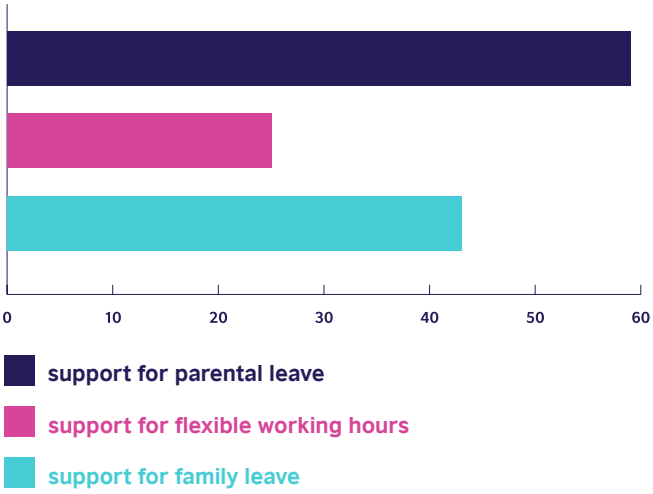
According to the Egyptian Civil Service law, enacted in October 2016, women are protected from dismissal during pregnancy as well as provided with paid maternity leave of four months (up from three months), covering up to three pregnancies. [24]This provides support to women to balance work and family responsibilities. They can also take two years' unpaid parental leave for childrearing with the additional option of going part-time. Meanwhile, working women in the private sector are entitled to 90 days of paid maternity leave. [25]Newly drafted labour laws put forth increasing this to 102 days, putting it in line with the civil service.

When asked about the provision of policies and structures for parental leave and flexible working, 68% of professional women reported that they felt there was not adequate support for parental leave, while 58% of the group reported that there were not adequate provisions for flexible working hours. One respondent highlighted that although "there are several supportive laws for the work of women in science [...] sometimes the application of these laws is inappropriate". In the interviews, women often reported that lack of representation in industry was in large due to inflexible hours and, more importantly, industry not wanting to hire women to avoid dealing with "women's issues", such as maternity leave or other family issues. Professional respondents were likewise positive about the level of adequate support policies and structures in place for family leave with 58% in agreement of the support offered for this.

Female Professionals



Female Students



In a similar vein, 59% of student respondents agreed that they felt there were adequate policies in place to support for parental leave (32% answered "I don't know") only 43% felt there was support for family leave (38% responded they didn't know) and only a quarter felt there was sufficient policy support for flexible working.

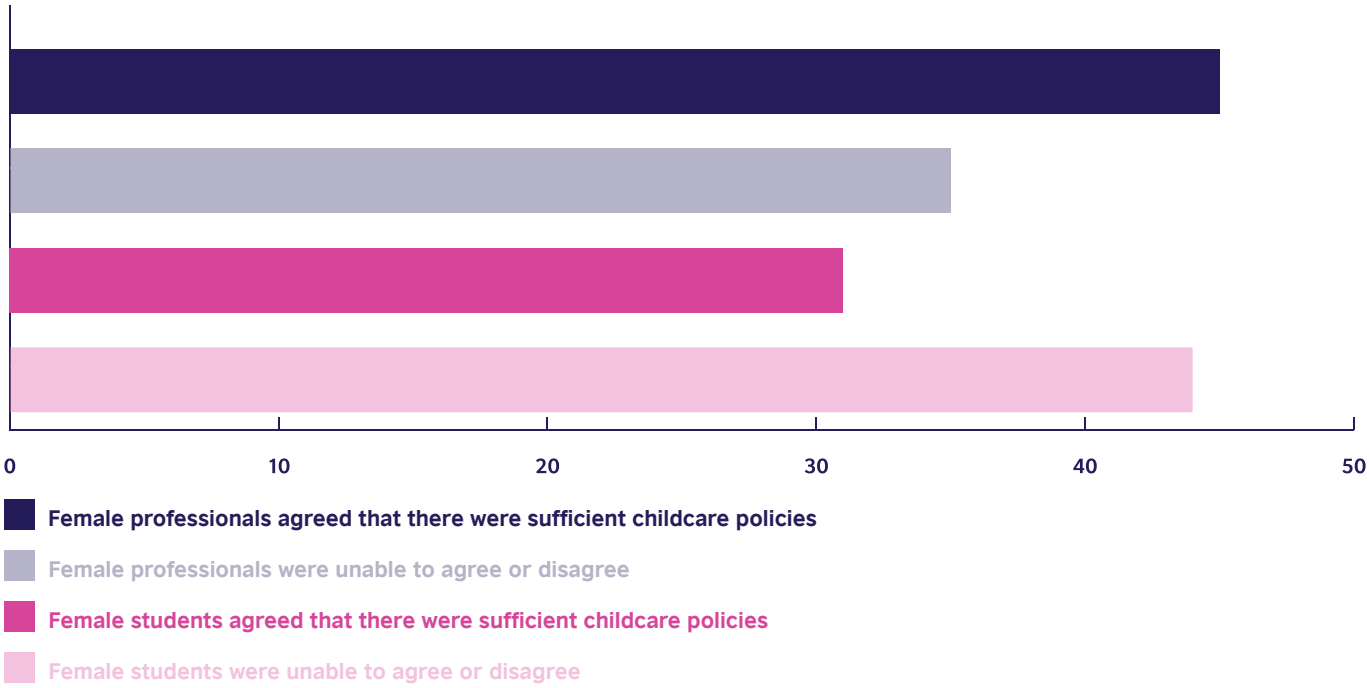
Egyptian law stipulates that employers in the private sector with 100 women or more in the workplace must provide childcare facilities. [26]This policy often leads companies to view hiring women negatively and means that fewer women (especially those with children) would be hired than might normally be. [27]This is consistent

24 World Bank. (2018, May). Study on Women's Economic Empowerment.
25 UNDP. (2018). Gender Justice & The Law. Published by the United Nations Development Programme (UNDP) in collaboration with the United Nations Entity for Gender Equality and the Empowerment of Women (UN Women), the United Nations Population Fund (UNFPA) and the United Nations Economic and Social Commission for West Asia (ESCWA).
26 UNDP. (2018). Gender Justice & The Law.
27 World Bank. (2018)

with what women reported in the interviews. The majority of the women in our sample expressed that working in industry was very difficult and the two main reasons for this were rigid working hours, which make it difficult to manage family and work life, combined with lack of options for child services and support. In its application, the law does hinder women's access to work, but requires further deliberate measures to ensure its effective application.

As with the interviews, we asked in the survey if the participants believe there are clear supportive structures for women in Egypt to pursue their careers in STEM. The answers from students and professionals are very similar. The surveyed data showed that 45% of professional women agreed that there were sufficient childcare policies (35% were unable to agree or disagree) while 31% of student respondents also agreed with a majority of 44% unable to agree or disagree. However, the majority of women, at the student and professional levels, believe that the existing policies in academia and industry need to change in order to make them more inclusive for women, with the focus on flexible hours to balance work and family life, as well as policies aligned with childcare, and promotions. Along similar lines, 60% of the women interviewed mentioned that there are already existing policies at the government and institutional level for supporting women but that those are often poorly implemented or not monitored, which has negative repercussions for women's professional development. Finally, 10% of women in our sample believe that currently there are no supportive structures or policies, but with the focus on research and not necessarily gender specific.

Childcare Policies Survey



Other policies, or government strategies to support women in STEM, include the NCW Strategy for Empowerment of Egyptian Women 2030. This initiative promotes digital technology programmes for women as part of vocational training and capacity-building programmes, as well as providing the different types of technical education. It also aims to ensure women's access to ICT. This shall in turn, enhance women's access and advancement in STEM sectors. Moreover, according to the NCW strategy, ICT is among the list of growing industries that not only provide opportunities for women to join, but also hold the potential to promote social justice and gender equality. The NCW asserts that research in other countries highlighted that increasing

women's involvement in such sectors is an effective strategy for empowerment. [28] While STEM is not specifically named by the NCW strategy, it constitutes a significant supporting element to promote women in STEM in Egypt.

28 National Council for Women. (2017). National Strategy for the Empowerment of Egyptian Women 2030. Available at: http://ncw.gov.eg/wp-content/uploads/2018/02/final-version-national-strategy-for-the-empowerment-of-egyptian-women-2030.pdf

In the interviews, a common theme for what women would like to see in the future for women in STEM in Egypt is more opportunities for professional development, entrepreneurship, and leadership, as well as more collaborations between industry, government agencies and researchers. They believe this is key for progress in Egypt. This should also be in combination with more interdisciplinary collaborations across research areas and disciplines, but these collaborations need to be promoted because currently there is little incentive and there seems to be cultural barriers preventing more of these collaborations. They believe that interdisciplinary and intersectoral collaborations will help grow the research, contextualise the solutions to the local issues, and create progress. Some of the initiatives should be targeted to create more robust networks and a networking system, such as more events or conferences where people can meet and exchange their ideas and research.

Data from the literature and the interviews, demonstrate that the strategies in place hold major potential to promote women's equal access to opportunities in the STEM field. Moreover, the structure of certain STEM fields, such as ICT, is an opportunity to promote women's inclusion in STEM. In particular, women surveyed and interviewed believe that there is a need for better and more transparent policies in the workplace, both in industry and academia, for job hiring and promotions. Twelve percent of the women in our sample were explicit in describing how there were not specific norms of expectations of how people would get appointed to positions and promotions, in repeated cases leading to what they perceived as unfair practices. Eighty percent of the women in our sample explained how they felt the expectations were different, in the sense that they felt they needed to put in many more hours of work and many more achievements than some of their colleagues in order to be considered for positions, government agency grants, and promotions. In a few cases, they expressed that it was not necessarily a gender issue, but that they felt discriminated against on the basis of either conducting their studies abroad or coming from a different institution. In these cases, they described how the competitiveness of the environment prevented collaborations and colleagues might felt threatened due to their different background, being then often penalised through the job responsibilities they were assigned or being passed over for promotions or being appointed to a permanent position.

Social barriers

What cannot be overlooked throughout this discussion is the role of social norms governing the gender dynamics in Egypt, while also regarding how it invariably permeates throughout the various socio-economic levels. The World Bank Study on Women's Economic Empowerment in Egypt attributes the gap between the high percentage of graduates in the STEM fields and their low representation in the positions of these specialization largely to social norms, and also as a result of forms of prejudice against them in

these sectors. The 2018 study addresses the idea that female leadership in the workplace is as important as political leadership. It highlights that the need for better visibility of female leadership in the workplace is essential to furthering the development of women in STEM[29]. Another report by the Organisation of Economic Cooperation and Development (OECD) on Women's Political Participation in Egypt, published in 2018, also purports one of major obstacles facing women's participation and representation in public life relates to gender norms (norms and practices embedded in the culture that hinder women's access in the public sphere directly and indirectly) and stereotypes. [30]This ties in with some of the themes observed in the interviews and surveys, in which,

when asked about whether they had experienced any challenges while pursuing their careers in STEM, students and professionals raised similar struggles, along the lines of lack of inclusion, discrimination, and stereotyping, often referred to as comments made by colleagues, not being awarded promotions -- sometimes citing that it was due to having to attend to family issues or not receiving clear explanations of the reasons why they had not been promoted. Among the social barriers mentioned is also the pressure to choose between families and career, which was particularly salient in rural areas compared to urban areas. Often women had to rely on supportive families and husbands in order to pursue their careers and they often narrated that on many occasions this was a process of adjustment or that in their family someone had already preceded them in the working sector, therefore opening the door for such opportunities, but that this was not the norm.

In addition, factors such as economic inequality (manifested through the informal gender wage gap, unpaid labour and low levels of female education) contribute to perceived social norms. It is contended that gender stereotypes that depict women as only wives and mothers result in them being overlooking in considerations for fellowships, scholarships or promotions and thereby play a role in hindering women's success in STEM fields [31-32] Women in the interviews mention how demanding academia is, citing their multiple responsibilities, ranging from lecturing, supervising students, curriculum development, completing administrative tasks, which are the norm for academics, but they often go above and beyond those responsibilities to work as advisors for government agencies, collaborating with NGOs and/or the United Nations, starting their own ventures, while also participating on committees, joining different forms of science communications activities, and any other initiatives that could help promote science and their work in general, to inspire more people. In part, they engage in all these multiple activities because they are all driven and very inspiring, high achieving women, but also because they feel the responsibility to be examples for more women to pursue leadership positions. However, some of the women interviewed mention that in order to achieve those leadership positions they need to go above and beyond their work to be considered for those types of promotions, so feel constant pressure to achieve. While the pressure to achieve might not be a particular gender issue but an early career issue, combined with social norms and stereotypes it puts women at a disadvantage when it comes to promotions and advancing in their career path.

The women in our sample believe that even though representation of females at undergraduate levels in STEM fields is high, there needs to be a bigger push at moving more women along the career path and into leadership positions. They proposed access to professional development opportunities, such as leadership and commercialisation workshops, entrepreneurship courses, and more practical courses on communication skills, preparation of curriculum, and transferable skills.

Representation of women in the private sector tends to be more limited due to longer working hours, which make it harder to balance work and other (largely household) responsibilities. Kassab argued that it is difficult for women to remain in jobs in the private sector after marriage, because the long hours make it harder for them to balance responsibilities (such as unpaid work within the home which falls largely on women) adding an estimated 17 hours per week after marriage. [33]This in part aligns with responses from the surveys in which the majority of women expressed

29 World Bank. (2018).
30 OECD. (2018). Women's Political Participation in Egypt. Available at: http://www.oecd.org/mena/governance/womens-political-participation-in-egypt.pdf
31 World Bank. (2018).
32 Elbadry, N. (2013, April). Women and Science in Egypt after the revolution: There is still a long way. Available at: https://www.natureasia.com/ar/nmiddleeast/article/10.1038/nmiddleeast.2013.47
33 Kassab, B. (2019). Women in the Labour Movement, In ed Bassiouny. Cairo. Pp. 13 – 45.

that there are unclear expectations and/or policies regarding the amount of time spent at work, and requirements for jobs and promotions. There was a clear agreement that the inflexible and large number of hours made it hard to balance their work and life, which often included looking after family. This study draws the conclusion that there is a higher percentage of unmarried women in private sector STEM fields such as ICT, although unmarried women constitute only 20% of the total number of women in the labour force. Therefore, there are more women working in the public sector, where issues such as more flexible and shorter working hours often apply.[34]

Job Security

Women mentioned a number of factors around job security which they saw as a challenge in developing and progressing their careers. First, there is a very high level of competition, particularly in some fields. A number of the interviewees mentioned that medicine and engineering were both very competitive and hard to find jobs in, particularly outside of academia, in addition to the difficulty of securing permanents position within research institutes. This means that the most viable career path for women is often academia, which is reflected in part in our sample. But even within academia, depending on the area of expertise and the type of institute, it remains difficult to find permanent and well-paid positions.

Within academia, representation of women within departments has changed considerably. However, it was frequently cited in the interviews that higher academic management and administrative positions were often dominated by men. While this fact in itself might not be pushing women away, the indirect consequences of it might be the lack of role models for women to follow into those positions or implicit discrimination. Some women cited that working environments in which men were the majority could often be not welcoming, the expectations of working hours were harder, and promotions were also harder to achieve. This is not to say that one is a direct consequence of the other. While the interviewees did not expressly link this causally, they felt there might be a connection in the fact that male colleagues might not understand women needing to balance family and career.

It was noted as difficult for women to find jobs in industry and medicine, particularly as service delivery practitioners. The reasons they cite are that, in many cases, industry does not want to hire women because they do not want to deal with women's issues, such as maternity leave and flexible hours. Added to these perceptions is the gender bias inherent in some male dominated workplaces that the job positions are just too hard on women and therefore they prefer not to hire them or that the environments are too male dominated and therefore not good for women, thus avoiding hiring them.

Other commonly cited challenges related to bureaucratic and financial challenges, referring to the lack of transparent policies for hiring and promotional process. As well as opaque processes on how to get funding for research for government-industry initiatives, the women interviewed often felt they were being passed over for others, whom they perceived as not having the same merits as them, causing a lot of frustration and discouraging them from continuing working in those areas.

Gender dynamics, bias and work-life balance

Balancing work and family responsibilities is a major challenge facing women; particularly when coupled with the lack of accessible and affordable childcare facilities in addition to a lack of affordable means of transportation. Women are burdened with childcare, especially in female-led households. As a result, older women tend to leave STEM fields as a result of lack of flexible hours that interferes with balancing work and family responsibilities. Such long hours also contribute to young women being deterred from pursuing STEM or families supporting their girls in ways that would impact their family life later on. From the interview sample, two different trends emerge regarding gender dynamics and work-life balance. Women in the earlier stages of their career, or those who do not have secure positions, were more open about the difficulties they faced in trying to pursue their careers as women in STEM. For example, mentioning disparities in the number of females vs. males at faculty level – in some fields – and in other leadership positions, as well as the difficulties in securing jobs in industry.

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They also raised that the long and inflexible working hours are a problem for women to continue pursuing their careers, explaining sacrifices that they had to make, how it had disrupted their families' lives and often relying on supportive families in order to be able to continue. Other women in the sample mentioned that because they chose their career, they had sacrificed having a family all together, finding it difficult to find supportive partners or simply lacking the time to find a partner. They believe that everyone has the same opportunities accessible to them as long as they are willing to work hard and put in the time. They also spoke of the progress that has been made in the last decades regarding representation of women in different fields, even citing a government push to achieve gender balance in government positions and an increase in women in other leadership positions. However, it is interesting to point out that while they say there is movement to achieve gender balance, they equally describe how some government positions are simply not available for women, or how academic positions are better for women because the conditions better support family life, expressing that they had sacrificed a lot of their family life and time with their children in order to put the hours in at work to achieve career progression.

The role of implicit biases, derived from social norms and stemming from gender stereotypes around women, plays a major role in hindering women's access and promotion in the STEM fields. Implicit bias unconsciously attributes certain traits to a particular gender based on societal or learned behaviour.

The results of the survey differed between the career professionals and students when asked 'if being female affected their studies or work?'; 61% of professionals agreed that being a woman had affected their studies, while only 34% of students agreed. The majority of professional women agreed that the gender bias was most apparent in being overlooked for promotion, lack of clear expectations for job requirements, lack of flexible hours and the lack of inclusion (or deliberate exclusion) and stereotyping within their workplace. Student respondents overwhelmingly saw inflexible hours as their main area of gender bias concern in addition to lack of inclusion and deliberate exclusion.

Women interviewed and surveyed, stated that cultural norms deter women from engaging in STEM. One interviewee expressed that "women are told to believe that their careers are not as important and chose family instead". Meanwhile, a survey respondent articulated that the women she works with are "constantly regarded by peers and students as being 'less technical' just for the fact that we are women" while another survey respondent noted "women are not encouraged culturally to pursue careers in STEM. There are very strict cultural rules about what roles women should have. If they achieve success, they are respected but it is in the journey that they do not get the support and even women themselves do not believe in themselves, there is jealousy among women who also fall into believing the cultural norms".

Another challenge was that women were often discouraged from pursuing certain career paths within STEM, for example often citing how engineering was not a career for women, or particular specialisations within medicine and research are also not seen as appropriate. Therefore, finding a placement or job would be very hard, which disincentivises women to pursue those paths. This is seen more directly with women who work in areas such as biology and heritage, petroleum engineering and medical fields (outside obstetrics and gynaecology, family medicine and paediatrics) where they might be in close contact with others outside of their immediate family. One woman recounted her story about deciding to study palaeontology:

My parents didn't like that at all as in our culture, it is unusual to have a woman work and do field work in vertebrate palaeontology, which requires camping in the middle of nowhere for weeks. My parents told me this department is not for girls. One of my relatives, who was working in the oil industry, supported my decision. He had a long conversation with my parents and convinced my parents to let me study geology and he promised them that he would find me a suitable job just after I graduate. Soon after, I also got engaged. I was as excited at all the good news happening at once, but things went against my will. My parents and my fiancée forced me to give up my postgraduate study and not to accept the new job. I have to admit that the wave was bigger than me and it broke my ambition. I surrendered to their decision and I accepted the new life, being a wife and gave up my dreams.

After years of life without science, she decided to investigate what she could do. She met with a professor who offered her a place on his training scheme and knew this is where she belonged.

I felt this is what I want to do for my rest of life exploring, camping in the desert, studying prehistoric life. My parents still have issues with me doing field work, which I can see in their eyes, but at the same time they are very proud of me when they see me on the TV talking about my work. For a long time, I didn't know what I would like to do in my life, but as a palaeontologist, it is the life that I have been looking for.

She has never felt happier about her decision but still feels pressure to choose between family and career. She goes on to recount how much she loves her job and even the long hours and criticism do not deter her from it.

I have changed, and changed the situation around me, and I will not allow anyone to take me back to that dark time in my life.

She has been able to use her career to teach her children a lot, allowing them to become "more sophisticated in their way of thinking". While there is still resistance from her husband and her parents, she knows he is proud of her. Being a woman in STEM has changed her perspective in life.

A study by the World Bank examined such stereotyping, saying that there is a general perception of women as not capable nor qualified, which is a barrier to women's full and effective participation and involvement in the public sphere. [35] This is also echoed by statistics from Baseera (The Egyptian Centre for Public Opinion Research) in 2014, as cited in the NCW Strategy for the Empowerment of Egyptian Women 2030, that 55% think women are not fit to hold certain positions regardless of their merits.[36] This hinders the inclusion of women in decision-making positions. In that vein, implicit biases result in exclusion of women from managerial positions or for field and outdoor work and hence reflects negatively on their performance review and decreases the likelihood of their promotion. [37]

35 World Bank. (2018).
36 National Council for Women. (2017).
37 World Bank. (2018).

Additionally, part of the implicit bias is viewing women's work as a luxury while men are considered the primary breadwinner and so more "deserving" of the job opportunity and the money. Statistics from Baseera also show that 82% of Egyptians believe men should be prioritised if there are fewer job opportunities without regards to competency. Furthermore, such bias may lead female managers to adopt toxic "masculine traits" to assert their authority such as bullying, aggression or extreme competitiveness with counterparts. [38]

Support

One key component to the success of the women interviewed and surveyed was the level of support they received from family, colleagues and partners. Ninety three percent of professional women who identified as having parental support felt either highly or very supported in their career and work. Where extended family support was identified, 70% of respondents reported positively that they were highly or very supported, while those identifying as having spousal and partner support stated that 75% of them felt highly or very supported.

I have always been encouraged to pursue my career, particularly by my daughter who often tells me that she is very proud of her mother. Seeing yourself through the eyes of others is a great motivation and satisfaction for continuing the work I do. My husband has always been very supportive and understanding.

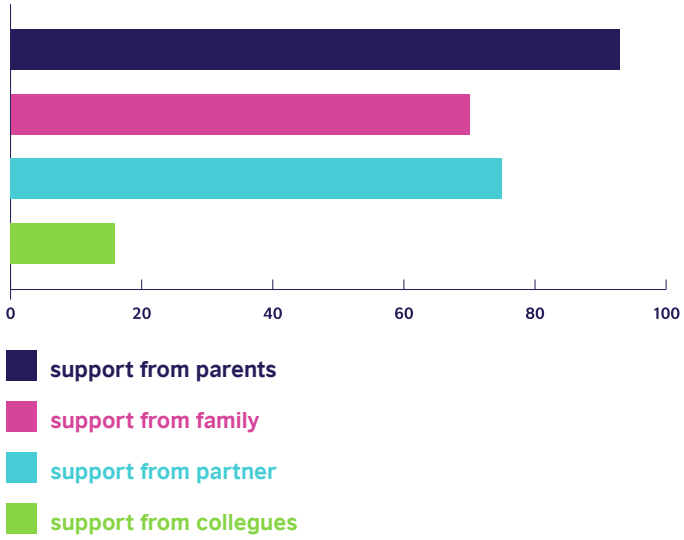
Interviewee

Many times, the women interviewed were quick to identify that their partners and spouses were also engaged in STEM, which made support for their work easier to accept.

Where this changed, was when professional women rated the support they received from academic colleagues and managers (where applicable). Only 16% felt they were highly or very supported. This is reflected in the earlier quote regarding how respondents have been affected by being a woman in STEM where they note 'we're constantly regarded by peers and students as being "less technical" just for the fact that we are women'.

In response to the same questions, students who identified as having parental support rated 81% of them highly or very supportive, while extended family support rated 69% as highly or very supportive. Of those students with partners and spouses, 83% of them said they felt highly or very supported. Much like the careered professionals, students rated their support from colleagues and managers at a lowly 39%.

Female Professionals Support



Female Students Support

Another important aspect of support is how, and if, women are able to support each other. In the case of support networks, the women, both students and professionals interviewed mentioned affiliation with women specific networks, such as the National Committee of Women in Science, Women in Science for Developing Countries, Women in Science Without

38 Ibid.

Borders, and other international and/or informal women's networks. The majority of the survey respondents indicated that they were not part of any female oriented networks (65% of careered professionals and 81% of students) but had some professional affiliation with networks related to their specific fields. Some women responded that they were not familiar with any networks, had no time for participating in networks, or chose not to engage with them.

These responses are in contrast to the responses from the interviews, in which the majority of respondents mentioned connections with informal networks formed in their departments, with colleagues, or simply using their families and friends as their support networks. However, the majority of those women did mention the importance of having more opportunities for networking and connecting with other people. There is a demonstrable need for women to connect professionally to share their work practices, as well as finding support and possible solutions for some of the struggles they face while pursuing their professional development.

Safety

Security in the workplace in terms of physical safety as well as gender-based violence in terms of sexual harassment in the workplace is not unique to Egypt or those who work in STEM fields.

According to the World Bank study, female employees often report verbal, physical or sexual harassment with no recourse to labour law in a field like agriculture in Egypt for instance. [39] Egyptian labour law prohibits sexual harassment in the workplace and can result in dismissal, a case can also be filed with the police resulting in punishment under the Egyptian penal code. Sexual harassment in the country has been a criminal offense since 2014; with intensified penalties in cases where the perpetrator has occupational or educational authority over the victim. [40]Nonetheless, there are hardly any measures to protect women from sexual harassment in the workplace. In fact, the victims are likely to endure various consequences if they complain, from victim-blaming, to losing their job as a result of insufficient proof. [41]

In 2016, CAPMAS launched Egypt's Economic Cost of Gender Based Violence Survey (ECGBVS) estimating that the total cost of the violence that women and their families were subjected to in 2015 is estimated to be from EGP 2.17 billion to EGP 6.15 billion calculating all violent incidents that women experience during one year. [42]The National Council for Women's Strategy 2030 recognises such challenges as a deterrent to women's economic empowerment overall.

There is a gap in the literature around sexual harassment in the workplace in Egypt, whether data or analysis. In recent years, there has been more recognition and work to combat it by non-governmental organisations (NGOs), such as the NGO Cairo Foundation for Law and Development, which adopts a legal approach supporting the survivors, and HarassMap, which adopts an institutional approach by delivering training workshops and drafting internal policies.

Recommendation and Conclusion

While there are several structural and systemic challenges to women's participation in the STEM field, largely concentrated on gender dynamics, there are multiple opportunities to be capitalised on to support women in

39 World Bank. (2018).
40 For law text, please see: Harassmap. (n.d). Egyptian Penal Code. Available at: https://harassmap.org/laws/law-text
41 UNDP. (2018).
42 UNFPA. (2016). The Economic Cost of Gender Based Violence Survey Egypt 2015 (ECGBVS). Published by UNFPA, CAPMAS and NCW. Available at: https://egypt.unfpa.org/sites/default/files/pub-pdf/Costs%20of%20the%20impact%20of%20Gender%20Based%20Violence%20%28GBV%29%20WEB.pdf

STEM and overcome hurdles. The major one of these is the high number of female students going into STEM subjects. Support to keep them engaged and to increase awareness at the early education stage may be the best way to further grow this demographic. What is more difficult is changing the mindsets of those inside the workplace and the gender biases that are prevalent, not only in Egypt but around the world. Hence, any proposed interventions should be multi-faceted.

The legal framework and state strategies, as well as the growing industries such as ICT, pave the way for promoting women in STEM. The multi-national companies, already working on women and girls in STEM, can be regarded as potential partners to support women in STEM in the private sector. Thus, capitalising on that and overcoming challenges, various procedures need to be in place.

While there are gaps in the educational attainment of women (predominately outside the metropolitan areas), when provided with opportunities, the women we surveyed have excelled in their studies to get the top of the class and into the prestigious programmes in the STEM arena. Where this falls down is when it comes time to access the labour market. It is not solely a matter of increasing numbers, it is imperative to sustain and maintain women's presence and thus reduce gender disparity by working to improve the direct conditions; including working hours, safety of the workplace, childcare and the indirect conditions in the private sphere such as unpaid household work, lack of support or cases of gender-based violence. This shall support women to not only join STEM fields but to advance in their pursuit of education, work and research accomplishments.

It is not all doom and gloom. Participants interviewed remained hopeful and encouraged by the future of women in STEM in Egypt. Despite the prevalent issues, interviewees often showed their pride for their profession and country, expressing a desire to help move the fields of STEM forward in Egypt and inspire others by becoming role models for girls and young women as well as making a difference and helping others through their work. Interviewees also believed in the importance of STEM to support nation building and contribute to economic growth. What was apparent was their passion for what they do and the appreciation of being recognised for their achievements.

Recommendations

The recommendations proposed to strengthen the future of women in STEM in Egypt are based on a small sampling of women who have participated in interviews, focus groups and an online survey. While not a representative group of the wider Egyptian society, they do offer some good insight to the world these career professionals and STEM students inhabit. They look at practical interventions that the British Council can engage with, and where they can affect the most change at the developmental and individual institutional levels.

What is proposed from the data collected for this report will help bolster the role of women in STEM and go some way to providing the awareness and support, needed to increase the number of women engaged with science, technology, engineering and mathematics.

Increase opportunities for more collaborations and networking

In an ever-connected world, the importance of building more collaborations between groups and across subject areas is best facilitated by partners who have the scope, scale, and reach to bring the right people together. Additionally, work with industry, government agencies, and researchers should be encouraged to show that there is not just one benefit of participating in STEM but that there are benefits to working in partnerships across sectors and disciplines to find better adapted and innovative solutions to tackle the local and greater global issues. Interdisciplinary and intersectoral collaborations will help grow the research, contextualise the solutions to the local issues, and create progress.

Interdisciplinary collaborations across research areas, disciplines, and sectors should be promoted and encouraged by external initiatives to create the change and break the barriers. Currently opportunities and incentives are few and perceived cultural barriers prevent further development of such collaborations. Some developmental initiatives should be targeted to create more robust interdisciplinary and intersectoral networks for women in STEM, as well as provide an effective networking system through the promotion of events, competitions, funding opportunities for interdisciplinary and collaborative projects, and/or conferences where people can meet and exchange their ideas and research.

Create a campaign to support and encourage women working outside of academia

The majority of the women in our sample stated that working in industry was very difficult. The two main reasons were the rigid working hours, which make it difficult to manage family and work life; and the lack of options for child services and support. The key to creating effective policy around women in STEM, is understanding what women really value in career choices and communicating these values.[43] Campaigns and policies should focus on changing perceptions of STEM careers to being compatible with family obligations. One way of achieving this is by creating strong associations between "STEM jobs", "working at home", "flexible work hours" and/or between "benefits for the family" and "equal partnership".[44] Another possibility is organising forums in which representatives from different sectors can meet with women in the field to discuss the needs and find joint solutions.

Encouraging policies that increase flexibility, not only for women in STEM but for everyone, leads to more balanced working situations for all employees. Instituting policies like this may help resolve issues related to gender biases, in which women report that they do not get hired because companies want to avoid maternity leaves or women having to deal with "family issues" (i.e. childcare or other family matters). Enacting parental leave that encompasses maternity and paternity leave, encourages the idea of childrearing as a shared responsibility. The World Bank study revealed male participants saying that work hinders their paternal responsibilities. [45]

Companies seeking to recruit women into STEM jobs should provide the necessary structural support for parents (e.g. on-site day-care, allowing employees to take sick days for family crises). These companies need to make changes in the workplace reality by decreasing barriers and adding benefits and not just communicating the "right" message about increasing the value of STEM careers to women.[46] Furthermore, it is vital to establish day-care in workplaces without requiring a certain number of female employees, to also promote shared responsibility in childrearing, including more accessible and affordable day-care centres.

Create professional development opportunities for leadership and a campaign to support women's leadership in STEM

While representation of females at undergraduate levels in STEM fields is high, there needs to be a bigger push to getting more women in leadership positions. The women in the interviews proposed access to professional development opportunities, such as leadership and commercialisation workshops, entrepreneurship courses, and more practical courses on communication skills, preparation of curriculum, and transferable skills, as well as the development of concrete support programmes for women in STEM at the different stages of their careers. This is not only in terms of financial support granted to girls or women in particular but includes mentorship and leadership programmes by other female leaders in their fields; whether research, education or technical work. According to the survey conducted as part of this research, the vast majority of women have acknowledged the significant support received in pursuing their careers in STEM from women's support networks. Enhancing and tailoring this support could have an immense impact on advancing women in STEM fields.

Finally, conversations and development of awareness about the issues women face in the workplace are very important in order for things to changed. The women in the study acknowledged the importance of the current study and the need for more of these conversations and spaces for these conversations to happen, including maybe conferences, forums, or campaigns to help raise awareness and identify solutions. Therefore, funding research to assess the status of women and girls in STEM - in rural and urban areas as well as across the socio-economic strata - is absolutely vital to produce more data to develop new and existing policies that tackle the root causes of inequalities.

43 Andreasen, A.R. (2002), "Marketing social marketing in the social change marketplace", Journal of Public Policy and Marketing, Vol. 21 No. 1, pp. 3-13.
44 Friedmann, Enav, (2018) "Increasing women's participation in the STEM industry: A first step for developing a social marketing strategy", Journal of Social Marketing, https://doi.org/10.1108/JSOCM-12-2017-0086
45 World Bank. (2018).
46 Ibid.

Role models

The women in our sample expressed the need for more female role models and mentors, but they also indicated that these role models and mentors need to be contextualised (of particular relevance to the target group) in order to be effective. That means that role models need to be not only exceptional cases, but women like themselves, who have worked hard, who come from all sorts of diverse backgrounds, and have still achieved great careers. In this regard, they look to have more spaces and channels to let their own stories be told and distributed for young people to see.

One approach to achieving this is through the launch of awareness and advocacy campaigns that enhance the visibility, participation, and image of women in STEM, engaging multiple stakeholders, such as government entities like ASRT and NCW, capitalising on their National Strategy 2030, and development agencies along with corporate social responsibility departments of companies in the private sector. In that process, it is imperative to adopt an intersectional approach that showcases women from different backgrounds, whether socio-economic status or location, in the portrayal of successful women. This will also make them more approachable when considering mentorship opportunities. The female participants will be able to highlight their achievements and how they overcame challenges – which is often overlooked when showcasing successes. It will provide opportunities for further engagement within and outside their field of STEM. More can be done to highlight female role models and the image of women in leadership positions, to demonstrate the various facets of what a woman engaged is STEM looks like, through mainstream and social media.

Create programmes to engage girls and young women in STEM in rural areas

A recurring theme was the difference in access children and young people in general had to STEM. There are few initiatives, outside of school, in which youth can engage with STEM and this is more acute in rural areas. A consequence of this is that young females do not see STEM as a viable career path, because they do not understand the different options and paths available to them. Furthermore, there are very limited options for students in rural areas to pursue those opportunities close to home, having to move to the city to do so, which is often not a possibility for young women. Initiatives that can engage current scientists, from different fields and sectors, with the community and general public in urban and rural areas, in ways that are relatable and develop awareness of everyday science, as well as career paths, is a possible solution to remedy some of these issues. This would also provide opportunities for the women in STEM to act as role models, train and practice science communication, disseminate their research, and possibly attract more females to pursue careers in STEM. Facilitating some of these initiatives could be integrated into the researcher's award responsibilities. The women in our sample believe that there is a great need for more widely accessible consumption of science among the general public. As one participant stressed "science is only going to be normalised and cool when scientists get as much airtime as sports figures and movie stars". This is particularly true if there is to be a push for improving STEM in Egypt, because the general public needs to buy in to the value of science, which could lead to more people being interested in joining STEM and collaborating, which in turn can lead to more funding for research. However, these types of programmes or initiatives need to incorporate practical experiences, so that the participants – girls and young women - can get a better understanding of the actual practices of the different STEM fields and what jobs and opportunities are available after obtaining a degree.

Partnership with other organisations

Another common theme among the women who participated in the study was the lack of information available regarding the different opportunities for funding, networking, and collaborations, nationally and internationally. Therefore, they suggested the creation of a web resource (database or website) in which researchers, at different stages on their career, can identify the different opportunities available. They believe that female students often do not further their studies because they do not know that there are resources available to support them. Also, early career researchers struggle to identify opportunities and resources for professional development, to support their research endeavours and identify options for their career paths. The web resource should contain a repository of different funding agencies, organisations and schemes available, as well as information about different calls, and maybe offer webinars for support in preparation for applications, such as writing proposals or creating a CV. This initiative should not be limited to the academic sector but should

also include, or have in parallel, opportunities to work with the private sector, such as launching internship programmes.

Conclusion

Gender diversity is needed in the STEM field to achieve economic vibrancy, innovation

and social equity goals, and failure to incorporate talented women is a waste of effective

human resources. [47] Our research sample shows that while women are engaging in STEM at the tertiary education level, it is the integration into the labour force which makes it difficult for there to be a more equitable distribution of women across all STEM-related sectors.

There is something of a dichotomy at play in our findings; there are significant numbers of young women engaging in STEM activity, despite there being considerable barriers to female engagement; there are considerable opportunities available to women through scholarships and policies, and yet structures and cultural norms are holding back true access and participation. Egypt has a strong tradition of female empowerment and development but remains patriarchal in many aspects of progress and opportunity; the number of women in STEM education does not translate to those in the work force.

These dichotomies speak to opportunity, rather than pure constraint. There exists an underlying foundation to support increased female participation and success in STEM and this needs to be further supported and grown to the point of institutional reality. Core barriers to engagement and access exist throughout and this means that there is no quick solution to the issue at hand, but rather the need for an overhaul of both approach and conceptualisation.

Work is needed at several intervention points; the point of entry where access and awareness are increased through discussion, knowledge and transparency; during the study period where women are mentored and supported in developing leadership skills and networks; and in the exit point when women should be encouraged to join the workforce (both public and private) in order to more fully harness and leverage the expertise they have gained during their studies.

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