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WOMEN IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) "EGYPTIAN CASE STUDY"*

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Abstract. The women representation in science, technology, engineering, and mathematics (STEM) fields in Egypt is spanning hundreds and even thousands of years back. Yet, there is efforts needed to show women's contributions in recent history and current time. This paper highlights the role of women in STEM and their role as main partners in the science, technology and innovation system, participation of women in science for both decision-making and the scientific community. The survey has been designed to look at and support the participation and progression of women in STEM professionals and to encourage more girls and women to continue their studies and practical life in the STEM Fields. 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. The paper reviews many challenges faced by women in science, technology and engineering and mathematics but from a practical point of view, where the questions are designed to reflect the scientific and leadership background as well as entrepreneurship and the relationship with the industry and to identify the obstacles that women face in being a business leader and the obstacles that women face in dealing with industry. Through the case study we unpack and examine the multiple thresholds of women and girls in higher education and employment in STEM fields in Egypt. The case study sample shows that while women are engaging in STEM at the tertiary education level, it is the integration into the labor 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.

Keywords: Women; STEM; Egypt; STEM survey; entrepreneurship

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1. Introduction

Women's engagement in the fields of Science, Technology, Engineering, and Math (STEM) is crucial for expanding knowledge, ensuring economic growth, fostering prosperity, and improving societal well-being (Jiang, 2021). The gap of gender differences in the fields of STEM can be shown in the unequal representation of women in publications, salary, senior positions, annual output, and the distribution of resources (Abuwatfa et al., 2021; Huang et al., 2020). The underrepresentation of women in science, technology, engineering, and mathematics STEM fields is a global phenomenon (Ceci and Williams, 2011). Women are less likely than men to enrol in STEM programmers and pursue jobs in STEM fields, even though the number of women joining these fields is expanding (Wang and Degol, 2016; Charlesworth and Banaji, 2019). There are several disparities in women's participation that cause their underrepresentation in STEM fields may be due to the influence of male-dominated environments that have sown the idea that STEM fields are masculine (Sarseke, 2017) However, a recent study found that Arab women's contributions to the scientific community have inevitably grown to be substantial and that their participation in STEM fields has become increasingly obvious (Darwish et al., 2020).

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 (Khalil et al., 2017). Despite significant improvement over the past few decades, there are extremely few female scientists working across the globe. According to the UNESCO Institute for Statistics, the average proportion of female researchers worldwide was just 29.3 percent in July 2019. The gap grows with seniority. Women have only received 3% of the scientific Nobel prizes given out to date. Even in tertiary education, there is a shortfall in STEM-related professions. Only 35% of students enrolling in STEM-related fields of study are women at this point, when specialization starts, and students decide which topics to take (UN Women, 2020).

According to the UNESCO Institute for Statistics, there is an estimated 45.3% of women engaged in scientific research in Egypt. (UIS-UNESCO, 2019). In Egyptian Science, Technology and innovation (ESTIO) report (2019) it estimated that 41% of women are in the field of natural sciences, 29% are in the field of engineering and technology, 49% in the field of medical science, and 35% are in the field of agricultural science. According to the CAPMAS 2017 bulletin of employment, wages, and working hours, 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 (11%), however the numbers change depending on the specific field (CAPMAS, 2018).

Many studies have been traying to know the impact of work environment on women working in STEM (Saxena et al., 2019; Fouad et al., 2016), showed that, negative affects toward women such as a severe criticism, belittling ideas, or intentionally directed derogatory comments frequently may take the shape of undermining women in the STEM workplace (Duffy et al., 2002), the female scientists' work does not get as much recognition as that of men, that appears in the number of men who receive scholarly awards and prizes compared to women despite efforts to increase the nominations of women (Lincoln et al., 2012).

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There are many initiatives that have appeared in the recent period directed at women in the STEM field such as Women-UP initiatives, is an Egyptian initiative funded by the EuropeAid and coordinated by the Academy of Scientific Research and Technology in cooperation with SEKEM Foundation and Techno Khair Foundation. women up program aims to empower women social entrepreneurs and female households as job creators through dual participatory approach (women-to-women loop) as well as empower women social entrepreneurs and female households as job creators through dual participatory approach (women-to-women loop). Women Up program worked to create forums and interactive discussion through the Women Entrepreneurs Platform. In addition to it provided technical support for the Women Entrepreneurs in Egypt (Training sessions and capacity building) and offered helpdesk for financial support and guidance for getting funding. Also, The ASRT manages several state prizes for women that recognize individual efforts such as Nile awards, state merit awards, state awards of excellence, as well as the state encouragement awards, which cover STEM filed specializations.

There are some international programs that support women in science, such as L'Oréal-UNESCO For Women in Science Egypt Young talents program fellowships, that aims to promote the participation of young women in STEM coming from Egypt, this program identifies and rewards talented young female scientists in the STEM field. USAID supports women entrepreneurs in developing their businesses and improving productivity through training, business incubators, career fairs, and corporate matchmaking events. This article highlights the barriers women face in STEM fields that create an unsupportive environment for women. The focus will be on female researchers in the STEM to provide recommendations for best practices to encourage women in research, development, and entrepreneurship, and to create an appropriate social environment for women's work in Egypt.

2. Methodology

2.1. Survey Design

The paper relied on data collected via an online survey. To get a fair reflection of the women researchers in Egypt, the survey is designed by Egyptian Science, Technology, and Innovation Observatory (ESTIO) affiliated to the Academy of Scientific research and Technology (ASRT), in cooperation with the British Council (BC) in Cairo. The target population for the Women in STEM Survey is targeted to women researchers in Egyptian research centers and universities working in the areas of science, technology, engineering, and mathematics (STEM). The sample was chosen randomly from the ESTIO database.

The survey was evenly distributed among the 30 research centers and universities covering all Egypt. It specifically targeted women researchers who have or are currently working in STEM fields. The questionnaire was designed to reviews examples of women who have inspired researchers to work in STEM, the efforts of women researchers to establish start-up or join in incubators and the obstacles that women have faced as entrepreneurs, in addition review any support received by women during their work in STEM. It also discussed the funding for research projects, available opportunities that women must exploit to lead in STEM and the challenges facing women in STEM community.

Also, the paper used some of data extracted from a woman in STEM case study of British Council in Cairo (British Council, 2021), that rely on the twenty-two participants were interviewed face to face, in small focus groups or through online meeting platforms. In addition to this, an online survey was widely distributed through various network channels. Of the 63 eligible survey responses, 32 were STEM students while 31 were employed in an area of STEM, the study based on the British Council in Egypt commissioned Pivot Global Education and Mariam Mecky a gender researcher to conduct the study on women in STEM.

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2.2. Characteristics of the Participants in the Survey

The survey covers 411 women researchers in 16 governmental research centers and 14 state and private universities in STEM fields, the 30% of the respondents work in natural sciences, while about 27% work in medical and engineering sciences and 16% of the respondents work in agricultural sciences (figure 1). In the survey the women researchers were asked whether they had completed their higher education (bachelor's degree) inside or outside Egypt. The results showed that most of the respondents to survey (95.6%) had completed their higher education inside Egypt and only 4.4% had completed their higher education outside Egypt. Meanwhile, the results showed that most of respondents obtained their masters and PhD degrees from Egypt, where only 2.9% and 8% of all respondents received their master and PhD degrees respectively from international universities.

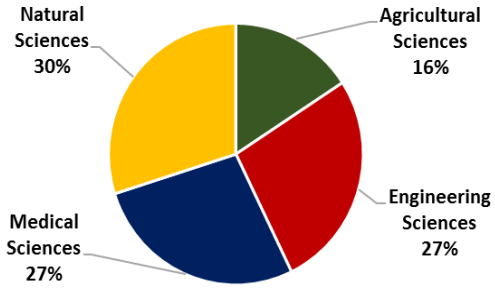

Fig. 1. Respondents Specializations
Source: the survey

The largest number of respondents to the survey were from researcher/lecturer degree, representing 36.5% of all respondents, followed by less than researcher/lecturer (24.1%), professor and professor emeritus (20.9%) and assistant professor (18.5%) respectively. The survey was targeting to get more information from young women; therefore, most of the respondents of the survey were from the age group between 25 and 40 years representing 70.3%. Only 8% of the respondents are experts over 60 years old (figure 2).

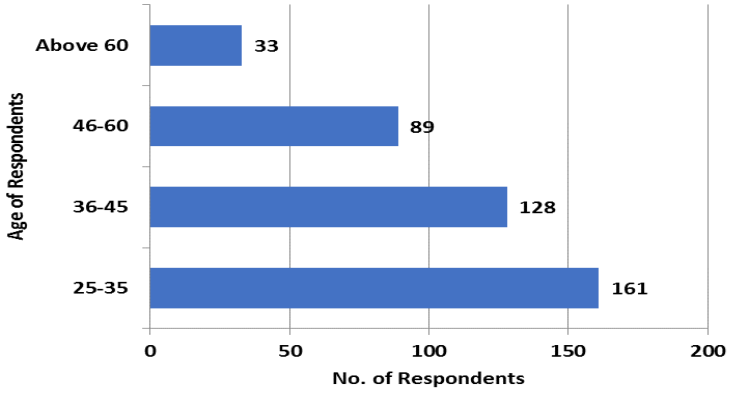

Fig. 2. Age of Respondents

Source: Results of the survey

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3. Results and Discussion

3.1. Leadership Positions and Historically Influential Figures in STEM

The respondents were asked if they had held any leadership positions within their organization or in another organization. The results showed that 40% of all women researchers held leadership positions during their work, the leadership positions varied by researcher degree across universities and research centres (Table 1). The results showed that there is a direct relationship between the academic degrees of female researchers and occupying of leadership positions, 85% of Professor/Professor Emeritus had held leadership positions. The women took over various leadership positions (head of a research center, the dean of a faculty, president and vice President of a university, head of a research department etc.

Table 1. Distribution of Leadership Positions by Research Degree

Researcher Degree	Women Researchers That have Leadership Positions		%
	Yes	No	
Less than Researcher/Lecturer	18	81	18%
Researcher/Lecturer	40	110	27%
Assistant Professor	32	44	42%
Professor/Professor Emeritus	73	13	85%
Total	163	248	40%

Source: Results of the survey

The role models, such as teachers, classmates, public figures, and teaching assistants, have been shown in the literature to be useful in attracting more women to STEM disciplines (Herrmann et al., 2016; Canaan and Mouganie, 2019; Mansour et al., 2021), When the women researchers were asked if they have a role model in STEM. The answers varied between the selection of historical and scientific personalities and among the eminent women scientists in the fields related to the researchers, but it was noticeable that for all women researchers they have one or more role models.

3.2. Women Entrepreneurship

In terms of creating new jobs and growing the gross domestic product (GDP), women can contribute significantly to entrepreneurial activity and economic development (Noguera et al., 2013; Kelley et al., 2017; Hechevarra et al., 2019), which can have a positive impact on lowering poverty and social exclusion (Langowitz and Minniti, 2007). The study of women entrepreneurs has grown significantly in recent years, gaining academic acceptance and, most importantly, helping in the knowledge of all the aspects that contribute to women's challenges in starting their own businesses (Cardella et al., 2020). Startups establishment is one of the top challenges facing women in STEM, as all researchers focus on publishing research, registering patents, and solving industrial challenges, but when they are moving from research to start a startup based on their innovations, there are many challenges facing them.

To understanding the challenges for women researchers to be entrepreneurs, the respondents were asked if they created Startups, or they have been trying to create start-ups and what challenges they are facing during creating the start-ups. The results showed that only 6.3% of women researchers have created start-ups through incubators, exist in their universities, research institutions, or through incubators funded by funding agencies such as the

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Academy of Scientific Research and Technology, while the majority (93.7%) have no activities related to entrepreneurship. (Figure 3).

Only 4.1% of women researchers were trying to establish Startups but their attempts were not successful due to many barriers. The main barrier that is facing the women researchers to be entrepreneurs is the difficulty in dealing with the surrounding environment that includes; the lack of training for academic and university professors, society's traditional view of women, women's family responsibilities, social and cultural restrictions, lack of knowledge of marketing methods , absence of women's awareness of entrepreneurship, lack of awareness among women about the procedures and the nature of projects that they can start with, difficulty in obtaining funds, difficulty in accessing the market, administrative and cultural issues and social duties.

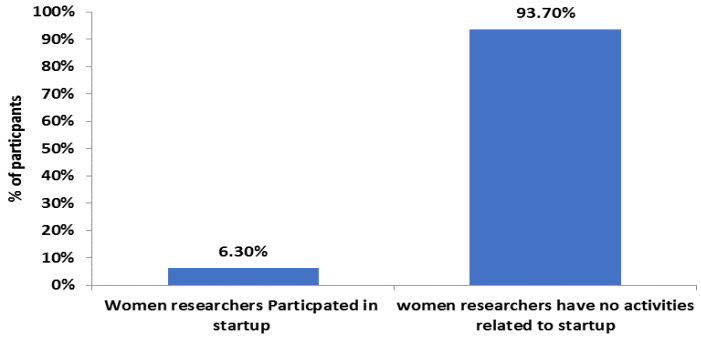

Fig. 3. Women Researchers participated in Startups

Source: Results of the survey

Also, the results showed that 44.3% of women researchers were facing some difficulties in the communication with industry. When the women researchers were asked to mention the top barriers that prevent them from working or collaborating with industry, the main barriers include; limited occupations to women, the difficulty of women presence in industrial areas, the lack of information about industrial partners, traveling abroad and being absent for long periods of time from home country, industrial work environment and location of industrial installations, the absence of communication channels between scientific research and industry and the difficulty of having women working in hard industries such as cement and petroleum explorations.

3.3. Social and Professional Impact of Women in STEM

The women respondents were asked to choose the degree of impact on their participation in STEM fields (negative, no change and positive), weather the impact on their family life, or social life, or professional life. The results showed that for impact on family life, 59.5% of women researchers consider their participation in STEM fields have a positive impact on family life, while 17.6% indicate that it has a negative impact and 23% consider has no change on family life (Figure 4).

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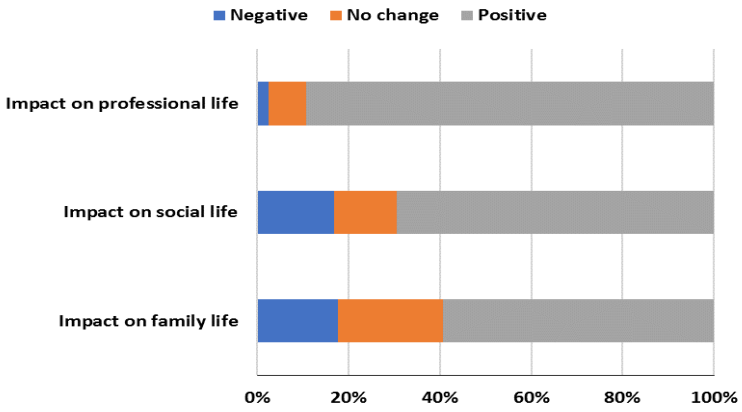

Fig. 4. Impact of Participation of Women in STEM

Source: Results of the survey

The results of survey on the impact of participation of women in STEM fields on the social life showed that 59.6% of women researchers consider that participation in STEM have positive impact on social life, while 13.6% indicate that participating in STEM has a negative impact and 13.6% consider that participating in STEM has no change on social life. As the family and social impact, the impact of the participation of women in STEM on professional life have the similar results showed that 89.3% consider that participation of women in STEM have a positive impact, 2.4% have a negative impact and 8.3% have no change on professional life.

3.4. Support to Women in STEM

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". Other policies, or government strategies to support women in STEM, include the Strategy for Empowerment of Egyptian Women 2030 (Egyptian Constitution, 2014).

The women researchers were asked were asked if they received any type of support in STEM fields such as Moral support from colleagues at work, managers, or from outside work (family, friends), or if they received financial support from their organizations, at the government level, or from outside Egypt or other bodies. The results showed that 86% of women researchers have received support in STEM fields while 14% didn't receive any kind of support, 67% of women receive support from people outside the field from family and partners and the rest receive support from colleagues. The results also showed that 81.5% of women researchers in STEM received financial support, including 37.2% from their work, 18.5% from the government and 8% from other sources (European Union, USA, etc.).

In the case of support networks, the women researchers in STEM fields 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 Borders, and other international and/or informal women's networks. Most respondents mentioned connections with informal networks formed in their departments, with colleagues, or simply using their families and friends as their support networks. However, many of those women did mention the

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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.

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 (Keune et al., 2019; Dasgupta and Stout, 2014). Moreover, the structure of certain STEM fields, such as ICT, is an opportunity to promote women's inclusion in STEM. 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.

3.5. Challenges Facing Women in STEM Fields

The participants were asked if they are facing any difficulties in integrating into STEM community. The results showed that 20% are facing some difficulties in integration into STEM community while 80% do not have any difficulties. Also, the respondents were asked also to choose the most important difficulties they are facing through the following options: difficulties to get a promotion at work, difficulties in dealing with other research agencies, difficulties to get a research fund, difficulties to get training, and difficulties in dealing with industry

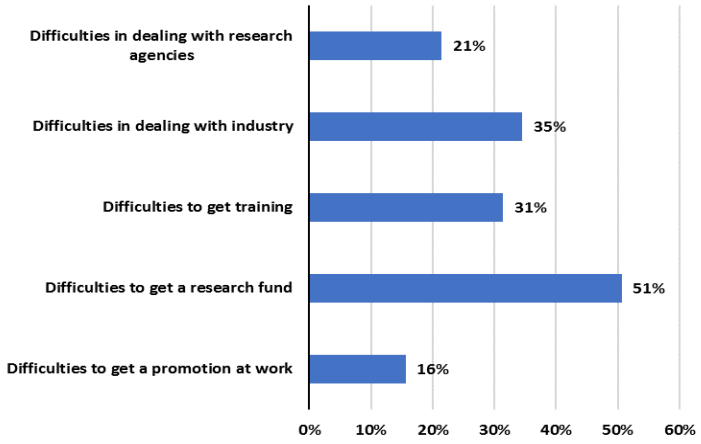

Fig. 5. Percentage of Women Facing Difficulties in STEM Field

Source: Results of the survey

The results showed that, the majority of women (50.6%) have difficulties to get a research fund from different institutions, while 15.6% of women researchers are facing difficulties to get a promotion at work, 31.4% have difficulties to get training to increase their capacity building, 34.5% have difficulties in dealing and collaborating with industry and 21.4% have difficulties in dealing with other research agencies (Figure 5).

Conclusions

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 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. Despite the existence of the financial or moral support for women in

STEM fields such as the supportive initiatives for women or government programs offered to them, but there is a clear deficit in entrepreneurship and cooperation with industry, that need more efforts from governmental to encouraging women in these directions.

The women in the interviews proposed access to professional development opportunities, such as leadership and commercialization 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 should include mentorship and leadership programmes by other female leaders in their fields. Partnership with other organizations. 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. 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.

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Data Availability Statement: More information and data can be obtained from the authors on a reasonable request.

Author Contributions: The authors contributed equally. All authors have read and agreed to the published version of the manuscript.

References

Abdulaal, M., 2018. Egyptian Women in the Workforce: Then and Now. Egyptian Streets. Retrieved from: https://egyptianstreets.com/2018/10/16/an-evolution-of-the-working-egyptian-woman/

Abuwatfa, W., Zamel, N., Al-Othman, A., 2021. Lessons learned from the underrepresentation of women in STEM: AI-enabled solutions and more. *Energy and AI 5*, 100086. https://doi.org/10.1016/j.egyai.2021.100086

British Council, 2021.Women in STEM in Egypt Case Study. Egypt. Published by British Council. Retrieved from: https://www.britishcouncil.org.eg/sites/default/files/british_council_booklet_spreads_-_2021.pdf

CAPMAS (Central Agency for Public Mobilization and Statistics), 2018. Annual Bulletin of employment, wages and working hours statistics 2017. Cairo, Egypt. Retrieved from: https://www.capmas.gov.eg/Pages/Publications.aspx?page_id=5104&YearID=23462

Canaan, S., Mouganie, P., 2019. Female Science Advisors and the STEM Gender Gap. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3396119

Cardella, G.M., Hernández-Sánchez, B.R., Sánchez-García, J.C., 2020. Women Entrepreneurship: A Systematic Review to Outline the Boundaries of Scientific Literature. *Frontiers in Psychology*, 11. https://doi.org/10.3389/fpsyg.2020.01557

Charlesworth, T.E., Banaji, M.R., 2019. Gender in Science, Technology, Engineering, and Mathematics: Issues, Causes, Solutions. *The Journal of Neuroscience*, 39, 7228-7243. https://doi.org/10.1523/jneurosci.0475-18.2019

Ceci, S.J., Williams, W.M., 2011. Understanding current causes of women's underrepresentation in science. Proceedings of the National Academy of Sciences 108, 3157-3162. https://doi.org/10.1073/pnas.1014871108

Darwish, S., Alzayed, S. and Ahmed, U., 2020. How Women in Science can Boost Women's Entrepreneurship: Review and Highlights. *International Journal of Innovation Creativity and Change*, 14(1), 453-470. https://www.ijicc.net/images/Vol_14/Iss_1/14145_Darwish_2020_E_R.pdf

Dasgupta, N., Stout, J.G., 2014. Girls and Women in Science, Technology, Engineering, and Mathematics. *Policy Insights from the Behavioral and Brain Sciences*, 1, 21–29. https://doi.org/10.1177/2372732214549471

Duffy, M.K., Ganster, D.C., Pagon, M., 2002. Social Undermining in the Workplace. *Academy of Management Journal*, 45, 331-351. https://doi.org/10.5465/3069350

Egyptian Constitution. 2014 at: https://www.sis.gov.eg/newvr/theconistitution.pdf [accessed 18 September 2022]

Fouad, N.A., Singh, R., Cappaert, K., Chang, W.H., Wan, M., 2016. Comparison of women engineers who persist in or depart from engineering. *Journal of Vocational Behavior*, 92, 79-93. https://doi.org/10.1016/j.jvb.2015.11.002

Hechavarria, D., Bullough, A., Brush, C., Edelman, L., 2018. High-Growth Women's Entrepreneurship: Fueling Social and Economic Development. *Journal of Small Business Managemen,t* 57, 5-13. https://doi.org/10.1111/jsbm.12503

Herrmann, S.D., Adelman, R.M., Bodford, J.E., Graudejus, O., Okun, M.A., Kwan, V.S.Y., 2016. The Effects of a Female Role Model on Academic Performance and Persistence of Women in STEM Courses. *Basic and Applied Social Psychology*, 38, 258-268. https://doi.org/10.1080/01973533.2016.1209757

Huang, J., Gates, A.J., Sinatra, R., Barabási, A.L., 2020. Historical comparison of gender inequality in scientific careers across countries and disciplines. Proceedings of the National Academy of Sciences 117, 4609-4616. https://doi.org/10.1073/pnas.1914221117

Jiang, X., 2021. Women in STEM: Ability, preference, and value. *Labour Economics*, 70, 101991. https://doi.org/10.1016/j.labeco.2021.101991

Kelley, D. J., Baumer, B. S., Brush, C., Green, P. G., Mahdavi, M., Majbouri, M., et al. (2017). Global Entrepreneurship Monitor 2018/2017 Report on Women's Entrepreneurship. Babson College: Smith College and the Global Entrepreneurship Research Association. https://scholarworks.smith.edu/conway_research/1/

Keune, A., Peppler, K.A., Wohlwend, K.E., 2019. Recognition in makerspaces: Supporting opportunities for women to "make" a STEM career. *Computers in Human Behavior*, 99, 368-380. https://doi.org/10.1016/j.chb.2019.05.013

Khalil, R., Moustafa, A.A., Moftah, M.Z., Karim, A.A., 2017. How Knowledge of Ancient Egyptian Women Can Influence Today's Gender Role: Does History Matter in Gender Psychology? *Frontiers in Psychology*, 07. https://doi.org/10.3389/fpsyg.2016.02053

Langowitz, N., Minniti, M., 2007. The Entrepreneurial Propensity of Women. *Entrepreneurship Theory and Practice*, 31, 341-364. https://doi.org/10.1111/j.1540-6520.2007.00177.x

Lincoln, A.E., Pincus, S., Koster, J.B., Leboy, P.S., 2012. The Matilda Effect in science: Awards and prizes in the US, 1990s and 2000s. *Social Studies of Science*, 42, 307-320. https://doi.org/10.1177/0306312711435830

Mansour, H., Rees, D.I., Rintala, B.M., Wozny, N.N., 2021. The Effects of Professor Gender on the Postgraduation Outcomes of Female Students. *ILR Review*, 75, 693-715. https://doi.org/10.1177/0019793921994832

Noguera, M., Alvarez, C., Urbano, D., 2013. Socio-cultural factors and female entrepreneurship. *International Entrepreneurship and Management Journal*, 9, 183-197. https://doi.org/10.1007/s11365-013-0251-x

Sarseke, G., 2017. Under-Representation of Women in Science: From Educational, Feminist and Scientific Views. *NASPA Journal about Women in Higher Education*, 11, 89-101. https://doi.org/10.1080/19407882.2017.1380049

Saxena, M., Geiselman, T.A., Zhang, S., 2019. Workplace incivility against women in STEM: Insights and best practices. *Business Horizons*, 62, 589-594. https://doi.org/10.1016/j.bushor.2019.05.005

UIS-UNESCO, Fact Sheet No. 55 June 2019 FS/2019/SCI/55. Retrieved from: http://uis.unesco.org/sites/default/files/documents/fs55-women-in-science-2019-en.pdf

UN Women, 2020. Women in science, technology, engineering and mathematics (STEM) in the Latin America and the Caribbean region Retrieved from: https://lac.unwomen.org/en/digiteca/publicaciones/2020/09/mujeres-en-ciencia-tecnologia-ingenieria-y-matematicas-en-america-latina-y-el-caribe

Wang, M.T., Degol, J.L., 2016. Gender Gap in Science, Technology, Engineering, and Mathematics (STEM): Current Knowledge, Implications for Practice, Policy, and Future Directions. *Educational Psychology Review*, 29, 119–140. https://doi.org/10.1007/s10648-015-9355-x

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