

## Women in STEM Education and Employment: Insights from University Students in Morocco

Jihane Benmassoud <sup>1\*</sup> & Aicha Bouchara <sup>2</sup>

<sup>1</sup> Cadi Ayyad University, Essaouira, Morocco

<sup>2</sup> Abdelmalek Essaadi University, Tetouan-Tangier, Morocco  
[benmassoud-jihane@outlook.com](mailto:benmassoud-jihane@outlook.com)

### ARTICLE HISTORY

Received : 2022-12-06

Revised : 2023-02-21

Accepted : 2023-02-28

### KEYWORDS

*Women in STEM*

*Gender stereotypes*

*Attitudes*

*Experiences*

*Awareness*

*Students' perception*



### ABSTRACT

Worldwide, women represent 35% of all students enrolled in science, technology, engineering, and mathematics (STEM) fields. In Morocco, 42.2% of women are engineering graduates. This study aims to investigate university students' attitudes, experiences, and awareness about men and women in STEM education and employment. An online questionnaire was adopted to collect both quantitative and qualitative data. Using convenient sampling, 181 STEM university students participated in this study from four different institutions in Morocco which are: Faculty of Sciences and Techniques in Tangiers, The School of Technology in Essaouira, Hassan II Institute of Agronomy and Veterinary Sciences in Rabat, and the Higher School of Technical Education in Mohammadia. The findings show that the majority of students (83.2%) do not perceive the STEM fields as typically masculine. A minority (6.7%) believes that some professors behave differently with male and female students. Moreover, most respondents (55.6%) were not aware of the underrepresentation of women in STEM fields and were unable to recognize the importance of their contributions to fixing society's challenges. This study, therefore, is relevant for decision makers in higher educational institutions to reconsider the methods and contents of STEM education in order to enhance a gender responsive pedagogy

## 1. Introduction

Gender parity and equality in the fields of education, research, and employment is essential to the achievement of the 2030 Agenda for Sustainable Development. Indeed, three sustainable development goals are targeted in this article: goal 4 which refers to quality education, goal 5 relating to gender equality, and goal 8 which is concerned with decent work and economic growth. The association and implementation of these three goals are keys to the achievement of a socio-economic growth for all. However, a lack of parity, gender bias, and stereotypes, as well as inequalities still negatively impact women's participation and empowerment.

On a global scale, the number of women graduates in tertiary education and research is described as a "leaky pipeline" (Huyer, 2015, p. 85). At the Bachelor and Master degrees, women form 53% graduates for each degree, but their progress into PhD diplomas and research careers decreases to become 43% and 28% respectively. Moreover, their participation in different scientific fields is usually concentrated in the health sector. They also represent only 35% of the total number of female students in

science, technology, engineering, and mathematics (STEM) globally (UNESCO, 2017, p. 23).

Nevertheless, the percentage of female engineering graduates is on the rise in sub-Saharan Africa, the Arab States, and parts of Asia. In Morocco, in 2018, the percentage of women graduates in engineering reached 42.2% compared to France (26.1%), Australia (23.2%), Japan (14%), or the USA (20.4%) (Bello et al., 2021). In fact, other Arab states have higher percentages such as Algeria (48.5%), Tunisia (44.2%), and Oman (43.2%). Bouchara (2022) states that this increase can be interpreted by the adaptation of Moroccan higher education to the changing needs of the national and global market and the careers of the future (p.16). These percentages, however, decrease in graduate and post-graduate levels; hence, confirming global reports. For example, in 2021, in the field of science and technology, Moroccan female graduates represented 56% of the total higher education diploma holders: 74% are Bachelor graduates, while 21% hold a Master degree, and a minority of 3% are PhD graduates (ENSSUP, 2021). Undoubtedly, this weak feminization rate in postgraduate education translates into a low percentage of female hired researchers. This situation

is related to different structural, economic, cultural and social constraints (Bouchara, 2022). Moreover, the transition from university studies into a career life is traced with barriers and difficulties for women in STEM. The UNESCO ground-breaking report (2017) *Cracking the code: Girls' and women's education in STEM* states that:

The highest level of attrition can be found at post-doctoral level as women do not take up careers in their fields of study, despite the large amount of time invested in education prior to employment. There are many factors that influence women's transition into STEM careers, including perceived compatibility of certain STEM fields with female identity, family obligations, the working environment and conditions. (p. 23).

The high feminization percentages in graduate studies and in STEM fields does not ensure a high rate in female employees. In fact, women often face a glass ceiling throughout their careers. Conforming to Huang et al. (2020), in addition to having shorter careers, they are also likely to leave the workforce at higher rates in different phases of their professional life. Moreover, according to OECD, International Labour Organization and Center of Arab Woman for Training and Research (2020), "Women in MENA represent nearly 48% of the total regional population of working age, but the female labour force participation rate only stands at 20%" (p. 36). It is clear that women's participation in the economic development is weak compared to their presence in different educational fields; which can be explained through different reasons. In fact, research on the underrepresentation of females studying and working specifically in the STEM fields has attracted the attention of educators, researchers, and policy makers since the 1970s and advanced in the 1980s. This gender gap in STEM has often been elucidated by different arguments including; cognitive abilities, gender stereotypes, issues of self-perception, career preferences, and few role models (Wang & Degol, 2017).

Concerning women and men's cognitive capacities in relation to scientific subjects, research has settled this question and showed that the gender gap in STEM is not caused by gender differences in ability (Ceci et al., 2009). Guiso et al. (2008) showed that countries with more gender equality reduced the gender gap in Mathematics test scores. Reilly (2019) asserts that sex differences in scientific performance is "partially determined by social and cultural processes, such as cultural beliefs and educational practices" (p. 15). This explains the reason for which some previous studies claim that even if girls get better grades in STEM subjects (Voyer & Voyer, 2014), males outperform females on high stakes standardized tests and spatial skills (Lippa et al., 2010; Voyer, 2011; Maeda & Yoon, 2013).

Findings also revealed the impact of gender stereotypes on girls and boys as parents may play an important role in shaping their children's expectancies and performance by communicating their own gender-biased beliefs about how girls and boys should perform in STEM subjects (Clewell & Anderson, 1991). For example, parents may have beliefs that males are better at STEM subjects than females (Jacobs and Eccles 1992; Tiedemann 2000a, 2000b). This socialization that girls and boys undergo within their socio-cultural environment forms a psychological factor against women's participation in STEM. Indeed, as they grow up, girls internalize a negative and false perception about both their cognitive capacities and about STEM as being not a woman's place. It has also been found that individuals are influenced by their relationships with their peers. Wang and Degol (2017) assert that "As children age, peers are also likely to become important influences of STEM course and career selection" (p. 10). This influence includes beliefs and behaviours, motivation and interest in different fields, and academic achievement. Therefore, if girls' environment reinforces gender bias in STEM, they are not likely to find themselves motivated to study STEM subjects as their female peers are also discouraged from studying or working in these fields.

Furthermore, gender differences in career preferences can also lead to females' underrepresentation in STEM fields. Su et al. (2009) stated in a meta-analysis study that males prefer working with objects, while females prefer working with other people. Therefore, even in STEM fields, females would more likely opt for professions that are people oriented. For example, according to Ceci and Williams (2011) the majority of females choose to major in the fields of medicine and environmental engineering which, according to Tai et al. (2006), explains that preferences could exceed ability.

Another issue that may affect the representation of females in STEM professions is that few successful female role models in STEM fields encourage young female students through media and national or international events (Hill et al., 2010). In addition, many female students are unaware of the existence of past or current successful women in STEM careers because of their scarcity and under-representation in media, textbooks, educational campaigns and events, and in decision-making positions.

Adding to these reasons, Legewie & DiPrete (2014) explain that school environments can have a major impact on female students' educational and career choices which may exclude STEM fields. Studies showed that "Professors may –consciously or unconsciously– perpetuate stereotypes since they are generally unaware of their own gender biases" (Bello, 2020, p. 35). Moreover, teachers in some classes may give more attention and encouragement to boys rather than girls because of these gender biases. Sadker et al.

(2009) observed in different class observations that teachers unintentionally attended to, praised and helped boys more than girls. Such teacher behaviour impacted girls' achievements "resulting in a lack of engagement, lower self-confidence, performance, and persistence in STEM course" (Heaverlo et al., 2013, p. 124). This gender-based discrimination in classrooms not only deprives girls from their right to receive equal treatment in class, but also fossilizes gender bias about females' cognitive capacities in STEM and leads to more girls dropping out or not choosing a STEM education.

The underrepresentation of women in STEM shows that the gender dimension in research and innovation is not likely to be considered. Bello (2020) explains that ignoring the gender dimension has "a negative impact in the quality and relevance of research and innovation. Not considering sex and gender in research can lead to poor results, the loss of resources and even put lives at risk" (p. 35). The presence of women and girls in STEM education and careers will benefit society as a whole by including a different perspective from the male-dominant one and by enhancing innovation. "In the field of innovation, the underrepresentation of women plays a significant role. Fewer women in STEM careers translates – among other things – to restrictions in creativity, innovation and competitiveness in innovative businesses (Soler et al., 2020; Gursch et al., 2022, p. 89). Women scientists and engineers contribute to scientific research and development in a way that can eliminate gender discrimination. These women can draw attention and find solutions to the problems that affect women's daily lives; their female perspective is better placed to know how their knowledge and skills can benefit women. Hill et al. (2010) assert that "Engineers design many of the things we use daily— buildings, bridges, computers, cars, wheelchairs, and X-ray machines. When women are not involved in the design of these products, needs and desires unique to women may be overlooked" (p. 20). Thus, the lack of representative female professionals, innovators, and entrepreneurs could lead to less investments which results in a market shortage in innovations that respect females' needs. Therefore, UNESCO (2017) and the European Union Funding for Research and Innovation (Hermansson et al., 2022) recommend that funding policies should be adjusted in different institutions and agencies to ensure an equal inclusion of the gender dimension.

In the educational field, the presence of women in STEM teaching positions can serve as role models for female students as long as they are confident in their competencies as "studies have found that while female teachers are more confident than their male colleagues at primary school level, their confidence decreases significantly by secondary school" (UNESCO, 2017, p. 52). Research is needed more,

however, on female teacher and student interaction and how it could benefit female students.

Previous studies in Morocco exploring the topic of women and gender in education and employment are mostly concerned with studying the feminization rate in these two domains, analysing governmental policies regarding the quality of education and equal employment opportunities, evaluating the alignment of the current status of these latter with international treaties and recommendations, and investigating structural, economic, and socio-cultural challenges which hinder women from accessing education and / or employment (Lazaar & Dasser, 2022; Bouchara, 2022, 2018; Ennaji, 2018; Manuy & Werkin, 2018; Zirari, 2010). However, there is a research scarcity about STEM education and careers. This scarcity is also related to studying the gender dimension within these specific domains. Moreover, there are limited references and studies about the perception of gender whether in educational or professional contexts by women and men involved in the STEM fields in Morocco. There is also a lack of knowledge and data about how young people perceive this gender difference; knowing that the youth are the pillars of a socio-economic growth of a nation.

This article, therefore, is exploring the attitudes, experiences, and awareness of Moroccan university students about women and men in STEM education and employment. The following questions are examined: What are the perceptions of female and male university students about the scientific capacities and skills of both genders in STEM education? Do they perceive their STEM instructors to treat them equally? Do university students perceive the STEM job market as a gendered equal space in terms of getting a job? And finally, how do students perceive the causes and impacts of the lack of female representation in STEM education and jobs? Understanding how young female and male students in tertiary STEM education perceive the gender dimension in their educational and professional environments in Morocco will inform educators and policy makers to develop innovative and inclusive strategies to increase women's participation and persistence in STEM fields.

## 2. Method

The present study adopted the quantitative method through the use of an online questionnaire which consists of 9 sections and is designed to be answered in 15 to 20 minutes. The online questionnaire format was used for the sake of representing a wide spectrum of views and experiences so as to encompass a large sample. Besides, it is a frequent tool for data collection because it provides anonymity, privacy and confidentiality that can help diffuse some of the fears and reluctance associated with completing research studies (Oppenheim, 1992).

Furthermore, the data derived from the online questionnaires was analysed to describe the basic features of the data in the study through providing summaries about the sample and the measures. The statistics that were used in the analysis are simple, clear and based on the frequency of each variable's responses and its proportions to the whole sample. The collection of data procedures was conducted over three months' period, resulting in a set of 181 completed students' responses. The selection of the participants was done through the use of convenient sampling, which involves the participation of respondents who are "convenient" to the researchers (Edgar & Manz, 2017).

By using one of the most important non-probability sampling procedures, namely convenient sampling, respondents are Moroccan STEM university students. Non-probability sampling incorporates a great variety of techniques from a sample chosen purely based on convenience, to an elaborate 'quota sample' in which respondents are chosen on the basis of several socioeconomic features (Saunders et al., 2012). In this study, convenient sampling was opted for because it assumes a homogeneous population. This technique argues that if a phenomenon, a trait, or characteristic does in fact exist, then it should exist in any sample. Besides, the power of convenience sampling allows the researcher to get the online questionnaire's results in one space of time to ensure a very high response rate. It is worthwhile noting the support of several English teachers in the selected universities, who provided easy access to the informants who study at four higher educational STEM institutions in Morocco which are: the Faculty of Sciences and Techniques in Tangiers, the School of Technology in Essaouira, Hassan II Institute of Agronomy and Veterinary in Rabat, and the Higher School of Techniques and Education in Mohammedia. These tertiary faculty, schools, and institute offer Bachelor, Master, and PhD degrees in STEM. These fields' educational programs are related to environmental engineering, mathematics, natural sciences, technology, computer science, geo-information, agricultural sciences, food science, horticulture, fisheries engineering, artificial intelligence, robotics, mechanical, electrical and industrial engineering, renewable energy, etc.

The respondents are all Moroccan university students in STEM fields, the majority of participants are males 56% and 44% are females (figure 1) and their age shows that 61,50% are between 21- 25 and only 36,90% are between 18-20 as shown in figure 2.

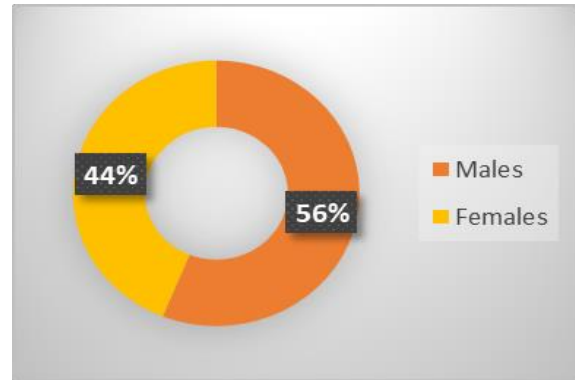


Fig.1: Gender of the participants

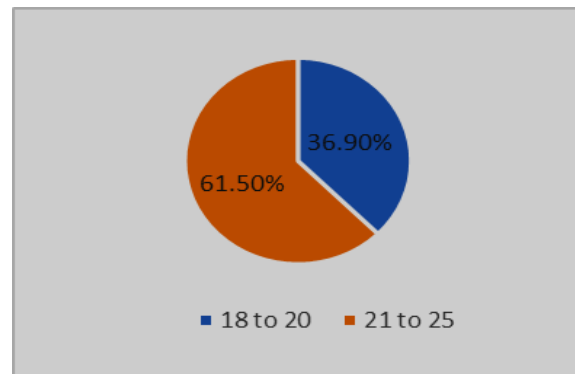


Fig.2: Age of the participants

The respondents are university students who have obtained a Baccalaureate degree (High school/secondary education diploma) and are pursuing their undergraduate university studies, Bachelor, and/or Master degree (figure 3). In fact, a majority of 42% have a Master degree or an equivalent Engineering cycle degree. They are followed by 32,40% having a Baccalaureate degree. Finally, the minority is represented by 25,60% having obtained a Bachelor degree.

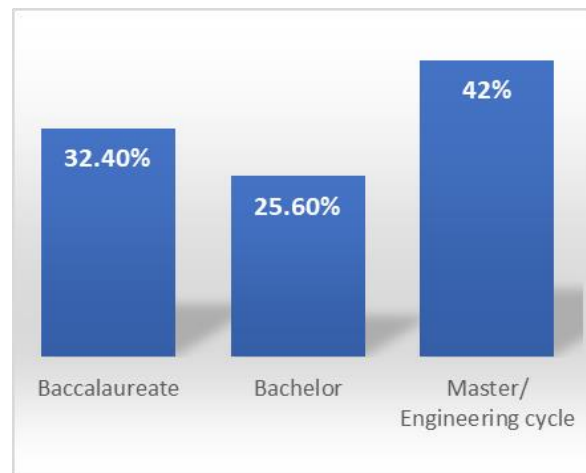


Fig.3: Participants' degrees

Moreover, all students are specialized in three main STEM disciplines as shown in (figure 4):

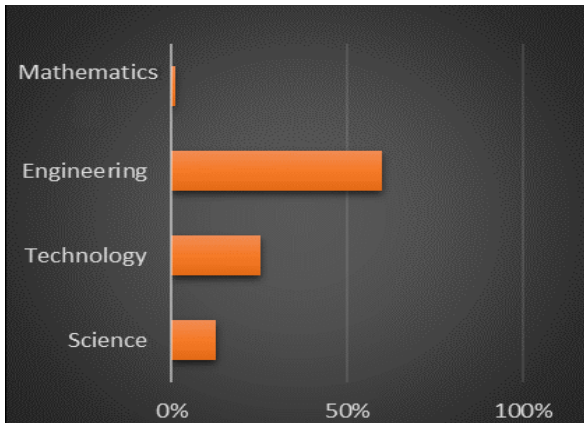


Fig.4: STEM disciplines

The majority of the respondents are studying or specializing in engineering with a 60% rate. 25% are in the technology field, 13% are in the sciences. However, the respondents in the Mathematic's field formed a very small minority of 1%.

### 3. Findings

As aforementioned, this study is concerned with university students' perceptions of gender in STEM fields in two Moroccan contexts, which are the educational and professional environments. Therefore, the results obtained reveal how students in STEM tertiary education perceive the ways gender intersects with cognitive abilities and human behaviour, influences women's and men's STEM education and career choices, and impacts the socio-economic development of their communities.

First of all, students were asked about women's and men's academic capacities in their educational context which is mainly within the limits of STEM fields. The majority of the students who participated in the survey (83.2%) think that both women and men are equal in terms of their academic excellence in the different fields of STEM, while 14% believe men to be better, and only 2.8% view women to be more successful in academia than their male colleagues.

Undoubtedly, academic excellence is related to many factors. One of these reasons is how professors interact and behave with their students during or outside classes. It is, then, primordial to question whether gender might affect this academic relationship between professors and students. Accordingly, based on their experience, the students were asked if they think female and male students are treated equally by their university professors in STEM classes. While a majority of 64.8% of the respondents assert that both genders are treated equally, 28.5% could not give their opinion. Moreover, according to 6.7% of the students, women and men are not treated equitably by their professors. This minority supports

its judgment through two different positions. One group claim's that females are favoured more than males in STEM classes because women are perceived to be more sensitive and, therefore, a professor could try to pamper a female student. Moreover, they affirm that in a conflictual situation between male and female students, their professors would more likely trust the female student as it is believed that professors perceive male students to be capable of dishonesty. Yet, the other group asserts that professors esteem male students more than females because of their cognitive and physical skills, which tend to be more developed than females. These respondents would write comments about how males have better logical thinking skills and are more able to manipulate machines during practical classes.

As mentioned in the introduction, the transition from the academic context to the professional one is filled with obstacles for newly graduated students, with females being more affected by this situation. It is, therefore, essential to question whether university students perceive the STEM job market to offer equal opportunities for women and men to become hired. A majority of 41.1% expect male graduates to obtain employment, while another 40% claims that both genders have equal opportunities. Moreover, despite being a minority, 18.9% argue that women are more fortunate in the STEM job market.

The underrepresentation of women in the STEM fields, whether in the educational or professional contexts, is a global situation, despite some differences between different countries. This unbalanced international and national setting seems not to be recognized by the majority of the students. In fact, 55.6% of university undergraduates and graduates are uninformed about this reality. However, 44.4% showed concern about the underrepresentation of women in STEM fields. Indeed, they listed several reasons which they perceive to affect women's motivation to pursue a STEM education and career.

Concerning STEM education, the respondents assert that women face obstacles related to the Moroccan educational system, the teaching body, and the nature of STEM education. Students pointed out that there is a lack of effective student orientation towards STEM fields at secondary education levels; which could encourage females to consider joining these specialties for their tertiary education. Besides, they assume that women may hesitate to join STEM education due to the fear of not being treated equally with men and, consequently, failing to graduate. The students pointed out that STEM fields consist of an arduous, demanding field path in terms of hard work, effort, and patience. In addition, they presume that physical strength is a feature that a student needs to have in some STEM subjects. Therefore, as the respondents perceive STEM as laborious and requiring bodily stamina, they suppose that it could discourage women from selecting a STEM university

program. Finally, some students claimed that the reason for the underrepresentation of women in STEM is that they are gradually becoming acquainted with these fields and that it will take time before reaching an equal gender representation.

Furthermore, students blame family, socio-cultural, and personal barriers for women opting out of STEM education. As they may influence students' academic path, some parents would favour male children to study STEM education because they believe it is lengthy and challenging. The reasons behind this gender-discriminating attitude are the deeply rooted stereotypes such as women's limited cognitive skills and competencies. In fact, students cited societal expectations which suppose women are better suited for fields such as healthcare, education, marketing, communication, literature, and fashion; which may likely influence women's academic choices. According to the respondents, these expectations and biases affect women's confidence in their capacities. Other beliefs that students mentioned can discourage women are that men may later have more opportunities to find a job in STEM fields. Moreover, the respondents supposed that women may not be interested in these domains or that there are insufficient female role models. Personal barriers related to marriage and childbirth at a young age may hinder women from STEM education and from receiving any kind of education according to them.

The underrepresentation of women in STEM jobs was also explained by the 44.4% of the students who were aware of this inequality for many reasons. Firstly, students condemn the recruiters' gender discriminatory culture. They assert that men are thought to be more competent than women to do the same job. Moreover, because of traditional family roles in which men have less responsibility towards their families than women, men are more likely to become recruited. Secondly, students logically concluded that the few numbers of female STEM professionals are coherent with few female graduates. Thirdly, the nature of STEM jobs may discourage women from either selecting them or continue working in them, according to the respondents. They assert that women do not like to take jobs requiring manual work, so they choose office positions as some gave the example of management careers.

Moreover, some STEM jobs demand the necessity to do field work which by definition means that a woman needs to be present in the public space to achieve her profession, while this is a situation described by some participants to be more acceptable for males than females. Another reason is related to motivation. Some suppose that women do not try to find a job opportunity as hard as males. Finally, the lack of acknowledging women's achievements in the STEM professional fields as equally as men's achievements may cause women's discouragement in

participating in STEM careers, according to the university students.

After exploring why few women participate in STEM education and employment, this study finally investigated the respondents' perceived impact of this situation. A majority of 45.6% of the students agreed that STEM fields are not negatively affected by the limited involvement of women in STEM education and employment. In comparison, 36.3% could not think if there is any negative impact, and a minority of 18.1% could define several positive outcomes should women become more represented in STEM fields. They asserted that women put forward new solutions and techniques to help solve world problems and enhance development. In addition, the respondents pointed out that hiring STEM female professors could produce more innovative teaching techniques to approach STEM classes. Finally, female professionals offer an added value to the labour market of STEM fields which would benefit tremendously from skills that women excel in; such as patience, sociability, creativity, integrity, organization, analysis, and problem-solving as listed by the respondents.

#### 4. Discussion

The results reveal that the majority of Moroccan female and male university students who study STEM have positive and equitable perceptions about women's abilities and skills in their specialties. The high numbers of young women graduates in Moroccan universities have indeed had an influential impact by producing a gender progressive mindset. As [Reilly \(2019\)](#) and [Guiso et al. \(2008\)](#) stated, social and cultural processes, such as cultural ideas and educational practices, have a role in how men and women perform in scientific fields. These young students have predominantly expressed that women and men have the same capacities that enable them to access, study, and work in the STEM fields. This also shows that gender-based stereotypes, which parents, family, peers, and schools disseminate, can dissolve when they are challenged on the ground. In fact, this finding contradicts the gender stereotypes on girls and boys in which parents may shape their children's expectancies and performance by communicating their own gender-biased beliefs that males are better at STEM subjects than females ([Jacobs & Eccles 1992](#); [Tiedemann, 2000a, 2000b](#); [Clewell & Anderson 1991](#)). In other words, if more women in STEM academia become visible, gender stereotypes about women's cognitive skills in STEM will eventually dissolve.

However, the high feminization rate which these students have been witnessing within their graduate academic context seems to obscure for them the reality about women's underrepresentation in the STEM postgraduate education and job market. In fact, a minority of respondents could identify this problematic, while 40% regard the job market to be an

equitable space for women and men. This might indicate that students lack the knowledge and enough awareness about future perspectives, challenges, and risks about their field of study. This could question the role of information diffusion media (television, social media platforms) and the academic role of schools and universities to raise awareness among the youth in general and university students in particular about the gender inequality in STEM. As according to [Legewie & DiPrete \(2014\)](#), school environments have a significant influence on the educational and career choices made by female students, which may steer them away from STEM professions. In fact, STEM students, especially females, need to speak to and hear from female professionals in the STEM fields or STEM alumni who have been through the same path as theirs in order to prepare them for the challenges that women face and how they can overcome them.

The role of tertiary education should not be limited to teaching technical or scientific subjects. Indeed, through this teaching lies an influential relationship between the teaching body of professors and female and male university students. As mentioned earlier, in several class observations, [Sadker et al. \(2009\)](#) found that teachers accidentally paid more attention to, praised, and assisted boys than girls. Girls' academic success was hampered by such teachers' actions, which caused a lack of engagement, decreased self-confidence, performance, and persistence in STEM courses ([Heaverlo et al., 2013](#)). Although results revealed that the respondents perceive professors at higher education to treat female and male students equally in the STEM classroom, which might indicate that faculty have adopted gender-neutral classroom management techniques, we cannot neglect the fact that 28.5% were unable to recall or identify whether their professors treated female and male students equally. This may imply that students are not aware of the manifestations of gender discrimination in teaching practices and, therefore, they were unable to determine if a certain behaviour or language is gender discriminating. Moreover, a small-scale minority (6.7%) referred to some unfair treatments by their professors, which were based on the belief that women are more trustworthy than men and / or that men are more intelligent and physically stronger to conduct manual experiments. This could reinforce gender bias not only in the teachers' behaviours but also in the male and female students' conceptions of flawed and limited gender capacities, which might affect not only their self-esteem but also their academic and future professional performance.

In addition, the respondents who expressed awareness about women's underrepresentation in STEM education and employment and believed men had more opportunities to be hired in the STEM job market were well aware of the barriers that hinder women from selecting and / or continuing a STEM

education and career. They explained that parents, recruiters and women themselves are limited by gender stereotyping, patriarchal norms, and the difficult and long working hours of STEM jobs. In fact, even if women graduate and start their career in STEM jobs, the majority is likely to stop their professional life as mentioned by [Huang et al. \(2020\)](#). In fact, women's role in society as major caretakers of their families is an essential barrier to women opting out of STEM and other careers in general ([Bouchara 2022](#)). Moreover, many STEM jobs, especially in the fields of civil and environmental engineering, necessitate working outdoors which could be an unsafe environment for women. Indeed, violence against women is still a problem in the public space in Morocco although it has decreased from 33% in 2009 to 13% in 2019 ([HCP, 2021](#)). Hence, the public space remains unsafe and non-normalized for women in general and female engineers in particular.

Another problematic revealed is that the great majority of the university students who participated in this study were unable to discern the impact of the lack of women in STEM. This can imply that students do not put the gender dimension within their perspective during their academic path. They may not perceive STEM as a vehicle to solve issues that are proper to women and their communities. We might also question whether university students are aware of the 2030 Agenda for Sustainable Development and its 17 goals in general, and, in particular, goal 5 referring to gender equality.

Accordingly, STEM subjects need to be further taught using a gender responsive pedagogy and with more practical ways by inter-relating gender with local and global political, economic, social, cultural, and environmental challenges. This could raise interest among female students and encourage them to pursue an education and career in these fields to later contribute to solving local and global problems, especially those linked to gender discrimination and bias as they are the ones who are most affected. It would also enlighten male students about the reasons for which it is essential for both men and women to contribute to the STEM field for the benefit of all communities as demonstrated by [Duflo et al. \(2012\)](#) who explained that the expanded participation of women does not only affect positively STEM fields but it has also a big impact on the economy as a whole.

Several recommendations were deduced based on students' opinions about improving women's involvement in STEM fields such as celebrating women's accomplishments in STEM fields by organizing governmental and non-governmental campaigns through traditional media (radio, TV, print media) and alternative media (social media networks, billboards, etc.) to sensitize and inspire students, parents, and recruiters by inviting female role models to university campus to share their success stories,

knowledge and experiences. As a matter of fact, Bello (2020) highlighted the crucial role of schools, universities and teachers in shaping female students' interest and the main impact they have on their performance in STEM.

It is also essential to provide coaching to young female students to strengthen their self-esteem and self-confidence in order for them to recognize and accomplish their personal goals. According to Hill et al. (2010), despite the small number of the existing female role models in STEM fields, they do not support young female STEM graduates through academic events on campus or by being visible in different media outlets. Indeed, these role models could be the most credible reference to show university women that a STEM career does not necessarily mean disregarding one's family responsibilities. Training these young women on different soft skills including personal development skills will help them develop their personal capabilities and potential and balance their family and job responsibilities. This is what Hajar Mousannif, a Moroccan university professor and data science researcher, asserts "I'm married and have three kids. I keep inspiring them (female students) and telling them that they can be good mothers, organize their time and achieve whatever they want" (Margit, 2021).

Furthermore, including female university alumnae in orientations starting from high school level to provide a practical perspective about the different domains in STEM fields for female students in order for them to make sound and informed decisions about their academic and career paths before integrating tertiary education. Since parents, in accordance with Jacobs & Eccles (1992); and Tiedemann (2000a, 2000b), could be influenced by the belief that males outperform females at STEM subjects, this can affect negatively female students' perceptions about their cognitive abilities and capacities in STEM majors. It is then the school's role to help and guide students during the orientation phase.

In addition, there is an urgent need to support working mothers by extending the newly introduced law by the Moroccan Ministry of Digital Transition and Administration in 2022 about a 15 days paternity leave to the entire public and private sectors; by offering on-site nurseries within work locations; by raising their salaries in order for them to hire assistants at home, and by re-considering the working hours and days. Such measures would encourage a lot of young Moroccan female students/employees to carry on studies and careers in STEM fields especially that one of the most distinctive problems as mentioned by Larouz & Benmassoud (2018) is "This tradition in which women are largely still identified with the domestic sphere and with caring/nurturing, extended family roles" (p. 307).

Finally, it is also essential to establish / ensure the application of a gender quota in research projects, funding policies and competitions for young female researchers. Similarly, UNESCO (2017, 2018), Hill et al. (2010), Soler et al. (2020), cited in Gursch et al. (2022) and Bello (2020) acknowledge the considerable positive impact of equal representation of gender on the quality and relevance of research and innovation in promoting scientific excellence, reducing potential biases, eliminating gender discrimination, finding possible solutions to the struggles that women face in their daily lives, and leading investments through innovations that fits females' needs.

## 5. Conclusions

The current research study examined Moroccan university students' attitudes, experiences, and awareness about men and women in science, technology, engineering, and mathematics (STEM) education and employment. The results revealed in this paper show that young women and men studying in tertiary STEM education have progressive views about gender in their field of study compared with the society to which they belong. This paper also showed that university students need change to be done not only at a micro level but also at a macro level. This means that gender equality is not required only from a quantitative perspective in tertiary education. However, it is primordial to re-think STEM education from a gender responsive pedagogy, while career paths need to be considered including a gender sensitive perspective in Morocco. In fact, there is a lot to gain from reducing gender disparities in STEM fields. The sustainable development of any society relies on inclusive and equitable quality education and decent work opportunities and conditions for all, regardless of their gender. Further research could examine a larger sample of STEM students from different Moroccan institutions to observe their cohesiveness. Other research instruments could be used such as focus groups and semi structured interviews to gather more data about the issue. Researching gender inequality in the STEM professional field might reveal systemic policies and socio-cultural obstacles which hinder STEM female graduates from either starting or continuing a career in this field.

## References

- Bello, A., Blowers, T., Schneegans, S. & Straza, T. (2021). To be smart the digital revolution will need to be inclusive: Excerpt for the UNESCO science report. *UNESCO Science Report*. <https://unesdoc.unesco.org/ark:/48223/pf0000375429>
- Bouchara, A. (2022). Les femmes à l'université marocaine: Des trajectoires fracturées. In Cahiers



- de Recherche, 2. *Observatoire Francophone pour le Développement Inclusif par le Genre* (OFDIG).
- Bouchara, A. (2018). Gender awareness and equality in TEFL: A comparative study. *Manuels Scolaires et Culture de L'égalité des Genres*: 133 – 161.
- Ceci, S.J. & Williams, W.M. (2011). Understanding current causes of women's underrepresentation in science. *PNAS*, 108: 8. <https://doi.org/10.1073/pnas.1014871108>
- Clewell, B. C. & Anderson, B. (1991). *Women of color in mathematics, science and engineering: a review of the literature*. Center for Women Policy Studies.
- Duflo E. (2012). Women empowerment and economic development. *Journal of Economic Literature*, 50 (4), 1051-79. <https://www.aeaweb.org/articles?id=10.1257/jel.50.4.1051>
- Edgar, T., & Manz, D. (2017). *Exploratory study. Research Methods for Cyber Security*. ScienceDirect. <https://doi.org/10.1016/B978-0-12-805349-2.00004-2>
- Ennaji, M. (2018). Morocco's experience with gender gap reduction in education. *Gender and Women's Studies*, 2(1), 1-18.
- Gomez Soler, S. C., Abadía Alvarado, L. K., Bernal Nisperuza, G. L. (2020). Women in STEM: does college boost their performance? *Higher Education*, 79(5), 849–866. <https://doi.org/10.1007/s10734-019-00441-0>
- Guiso, L., Monte, F., Sapienza, P., & Zingales, L. (2008). Culture, gender, and math. *Science*, 320(5880), 1164-1165 <https://doi.org/10.1126/science.1154094>
- Gursch, S. Urak, K. Herold, M. & et.al. (2022). Inequalities for women in science, technology and innovation. *Proceedings of the 5th International Conference on Gender Research*, 88-96. <https://www.gender-sti.org/wp-content/uploads/2022/06/Gender-equality-in-STI.pdf>
- Haut Commissariat au Plan (HCP). (2021). La femme marocaine en chiffres : 20 ans de progrès. <https://www.hcp.ma/file/224050>
- Heaverlo, C. A., Cooper, R., & Lannan, F. S. (2013). Stem development: Predictors for 6th-12th grade girls' interest and confidence in science and math. *Journal of Women and Minorities in Science and Engineering*, 19 (2), 121-142. <https://doi.org/10.1615/JWomenMinorScienEng.2013006464>
- Hermansson, K., Jacobsson, C., & Österberg, R. (2022). *Gender-net plus: Promoting gender equality in H2020 and the ERA*. Horizon 2020: European Union Funding for Research and Innovation.
- Hill, C., Corbett, C., & St. Rose, A. (2010). *Why so few? Women in science, technology, engineering, and mathematics*. American Association of University Women. <https://eric.ed.gov/?id=ED509653>
- 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(9), 4609–4616. <https://doi.org/10.1073/pnas.1914221117>
- Huyer, Sophia. (2015). *Is the gender gap narrowing in science and engineering?* UNESCO Science Report: Towards 2030. UNESCO: Paris. <https://unesdoc.unesco.org/ark:/48223/pf0000235447>
- Jacobs, J. E., & Eccles, J. S. (1992). The impact of mothers' gender-role stereotypic beliefs on mothers' and children's ability perceptions. *Journal of Personality and Social Psychology*, 63(6), 932–944. <https://doi.org/10.1037/0022-3514.63.6.932>
- Larouz, F. & Benmassoud, J. (2018). The status of women in higher education in Morocco. In M. Guamguami, M. Zerrouh, B. Elkouy (Eds.), *Culture, society and education: An interdisciplinary reader*. Dar Al Maha.
- Lazaar, A., & Dasser, S. (2022). A look at gender wage discrimination in the Moroccan labor market: A micro-econometric analysis. *International Journal of Accounting, Finance, Auditing, Management and Economics*, 3(5-2), 807-830. <https://doi.org/10.5281/zenodo.7195482>
- Legewie, J. & DiPrete T.A. (2014). The high school environment and the gender gap in science and engineering. *Social Educ.* 87 (4): 259-280. <https://doi.org/10.1177/0038040714547770>
- Lippa R.A., Collaer M.L., & Peters M. (2010). Sex differences in mental rotation and line angle judgments are positively associated with gender equality and economic development across 53 nations. *Archives of Sexual Behavior*, 39, 990–997. <https://doi.org/10.1007/s10508-008-9460-8>
- Maeda Y. & Yoon S.Y. (2013). A meta-analysis on gender differences in mental rotation ability measured by the Purdue spatial visualization tests: visualization of rotations (PSVT: R). *Educational Psychology Review*: 25, 69–94. <https://doi.org/10.1007/s10648-012-9215-x>

- Mansuy, M. & Werquin, P. (2018). Moroccan youth and employment: Gender differences. *Journal of Education and Work*, 31:5-6, 545-562, <https://doi.org/10.1080/13639080.2018.1541504>
- Margit, M. (2021). Women changing the face of science in the Middle East and North Africa. *The Jerusalem Post*. <https://www.jpost.com/middle-east/women-changing-the-face-of-science-in-the-middle-east-and-north-africa-658745>
- Ministère de l'Éducation Nationale, de la Formation Professionnelle de l'Enseignement Supérieur et de la Recherche Scientifique (ENSSUP). (2021). *L'enseignement supérieur en chiffres 2020-2021. Direction des Stratégies et des Systèmes d'Information*.
- OECD, ILO & Center for Arab Woman for Training and Research. (2020). *Women at work and in society: The state of play. In Changing laws and breaking barriers for women's economic empowerment in Egypt, Jordan, Morocco, and Tunisia*. OECD Publishing. <https://doi.org/10.1787/456fed82-en>
- Oppenheim, A.N. (1992). *Questionnaire design, interviewing and attitude measurement*. Pinter Publishers.
- Reilly, D. H. (2019). *Sex differences in cognitive abilities and educational outcomes: examining the contribution of sex-role identification* [Unpublished PhD thesis]. Griffith University, Gold Coast.
- Sadker, D., Sadker, M., & Zittleman, K. (2009). *Still failing at fairness: how gender bias cheats girls and boys in schools and what we can do about it*. Simon & Schuster, Inc.
- Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research methods for business students. (6th Ed.)*. Pearson Education Limited.
- Su R., Rounds J., & Armstrong P.I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological bulletin*, 135(6), 859-884. <https://psycnet.apa.org/doi/10.1037/a0017364>
- Tai R.H., Liu C.Q., Maltese A.V., & Fan X. (2006). Planning early for careers in science. *Science*, 312. <https://doi.org/10.1126/science.1128690>
- Tiedemann J. (2000a). Gender-related beliefs of teachers in elementary school mathematics. *Educational studies in Mathematics*, 41(2), 191-207. <https://doi.org/10.1023/A:1003953801526>
- Tiedemann J. (2000b). Parents' gender stereotypes and teachers' beliefs as predictors of children's concept of their mathematical ability in elementary school. *Journal of Educational psychology*, 92(1), 144-151. <https://psycnet.apa.org/doi/10.1037/0022-0663.92.1.144>
- United Nations Educational, Scientific, and Cultural Organization (UNESCO). (2017). *Cracking the code: girls' and women's education in science, technology, engineering and mathematics (STEM)*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf00000253479>
- United Nations Educational, Scientific, and Cultural Organization (UNESCO). (2010). *Experts workshop gender issues in education in the Arab states*. <http://unesdoc.unesco.org/images/0021/002107/210798e.pdf>
- Voyer, D. & Voyer S.D. (2014). Gender differences in scholastic achievement: a meta-analysis. *Psychological bulletin*, 140(4), 1174–1204. <https://psycnet.apa.org/doi/10.1037/a0036620>
- Voyer, D. (2011). Time limits and gender differences on paper-and-pencil tests of mental rotation: a meta-analysis. *Psychonomic bulletin & review*, 18, 267-277. <https://doi.org/10.3758/s13423-010-0042-0>
- Wang, M. T. & Degol, J. L. (2017). Gender gap in science, technology, engineering, and mathematics (STEM): Current knowledge, implications for practice, policy, and future directions. *Educational Psychology Review*, 29(1). 119–140. <https://doi.org/10.1007/s10648-015-9355-x>
- Zirari, H. (2010). Women's rights in Morocco: Assessment and perspectives. *Culture and Society: Development and Cooperation. IEMed*. 264-270. <https://www.iemed.org/publication/womens-rights-in-morocco-assessment-and-perspectives/>