

Louvain School of Management

Women in STEM: an intersectional approach to analyzing the trajectory of women and ethnic minorities in STEM studies and professions in Belgium

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List of Abbreviations

KAP: Kot-à-Projet

NAS: National Academy of Science

NSB: National Scientific Board

NSF: National Science Foundation

SDG: Sustainable Development Goals

STEM : Science, Technology, Engineering, Mathematics

UCLouvain: Université Catholique de Louvain

ULB : Université Libre de Bruxelles

UN: United Nations

US: United States

USA: United States of America

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Part I: Introduction

1. Context

We still live in a world where **gender inequality** and racial discrimination are pressing **societal challenges**. Reducing disparities is part of the 17 Sustainable Development Goals (SDG) set by the United Nations (UN). The UN has set targets for reducing inequalities, such as empowering and promoting social, economic, and political inclusion, regardless of age, sex, disability, race, ethnicity, origin, religion, economic or other status by 2030 (SDG's United Nations). However, according to the UN, the health crisis has contributed to exacerbating existing inequalities. Inequality and discrimination are related to wages, employment, and education and seem to be a factor influencing women's career paths. Especially in STEM -an acronym that stands for the four primary disciplines of Science, Technology, Engineering and Mathematics (Koonce et al. 2011) these inequalities persist to a great extent. For our master's thesis, we have decided to research women in STEM in Europe, most specifically in Belgium, focusing on women from ethnic minority groups.

The **underrepresentation of women in STEM** has been extensively researched in the last thirty years by American scholars (Clewell and Campbell, 2002 [as cited by Johnson, 2011]). Much research has focused on gender diversity in STEM. Existing literature refers to the **leaky pipeline** metaphor to describe the tendency of women to leak out of STEM in different career stages (Grogan, 2018; Liu et al., 2019). This disequilibrium started at early stages: from **high school** young girls that would rather drop any application for STEM-field for college due to the obstacles and environmental factors encountered; to **undergraduate** and **professional women**.

Although these studies are important, they often lack an **intersectional perspective** (Miriti, 2020). Consequently, we now know a lot about the gender gaps and different career experiences of men and women in STEM (Beede et al., 2011). Yet the obstacles faced by ethnic minority women¹ remain underemphasized (Liu et al., 2019). The few studies that have engaged with these issues show that ethnic minority women face not only gender but also racial stereotyping

¹ The term "ethnic minority" is preferred over 'immigrant' due to its negative connotation (Benedikter, 2008), and is used here to refer to people with an ethnically diverse background or origin (Kahanec et al., 2010, p.6).

(McGee et Bentley, 2017). This simultaneous experience with both sexism and racism is referred to as “**double bind**” (Ong et al., 2011). Moreover, these stereotypes are detrimental, not only to individual well-being but also to the performances of ethnic minority women in STEM (Beasley et Fisher, 2012).

In terms of **STEM education**, statistics on a global scale show that women represent only 40% of graduates in computer sciences, 28% of graduates in engineering and 22% of graduates in artificial intelligence (RTBF, 2021). The statistics for Belgium show a slightly lower number of female graduates in engineering (23%), but a drastically lower number for the participation of female graduates in computer sciences (10%) in 2017 (RTBF, 2021).

Moving onto **STEM employment** then, a recent report shows the participation of women in Western Europe in STEM-related research jobs does not exceed 40% (The Institute of Statistics of the United Nations, 2019). Also, in the United States of America (USA), women lack behind in STEM fields, with only 25% in computer sciences and 15% in engineering in 2019 (U.S. Census Bureau, 2021).

The problem of ethnic minority women “opting out” of the STEM field may have some devastating effects on **scientific advancements** (Chen 2015). First, women represent half of Europe’s population (World Bank, 2018), and due to massive immigration and globalization, this group is becoming more and more heterogeneous. We need both men and women, including those of color and with ethnically diverse backgrounds, to work together to help solve the great **societal challenges** of the present and future that affect each one of us. To attract the best and brightest minds, and prevent a shortage of labor, companies need to make sure ethnic minority women are not excluded from their workplaces (RTBF, 2020). Secondly, research has shown that more diverse teams outperform than homogeneous ones, leading to more innovative and creative solutions, and ultimately more profitability for companies (Dixon-Fyle et al., 2021). Indeed, the **cultural intelligence** of the diverse teams is higher than in non-diverse teams due to the differences in terms of background and this benefits innovation, which is especially key to the STEM-fields (Gibbs, 2014; Martin, 2014).

Apart from the economic issues related to ethnic minority women “opting out” of the STEM field, there are also ethical arguments in favor of including more ethnic women in STEM-related fields to the ideology of **equal opportunities**. Indeed, increasing the representation of

ethnic minority women in STEM also has a social purpose in our society. In that sense, diverse teams in STEM are crucial for ensuring that innovations are inclusive to the multicultural and multi-gender population. Including ethnic minority women in research and development is thus also a societal obligation. The lack of diversity of women in STEM in Europe thus prevents organizations from staying competitive and innovative to solve societal issues (Delnevo, 2021).

2. Research question and overview of the methodology

The focus of our master thesis is on understanding how European organizations in the STEM-field sector can deal with and benefit from diversity and maintain and attract more diverse talents. **Empirically**, we focus in this thesis on the experiences of ethnic minority and majority women in Belgium², at undergraduate, graduate, and professional levels, through **qualitative, in-depth interviews**. We designed two interview guides, one for students in STEM studies and the other for professional women. We analyzed the data collected during our interviews and compared it with the literature review to address our overall research objective, which is: to examine the role of the context on women's individual trajectories in STEM education and jobs.

The following **research questions** will guide our analysis:

- *What roles do sexism and racism play in determining the career trajectories of women in STEM? And does this experience differentiate according to ethnic origins?*
- *What are “good practices” that help combat sexism and/or racism in STEM?*

3. Structure

This thesis is structured into five parts. Starting by this introduction, then we will provide a good understanding of previous studies that have been done on women in STEM, thus setting the context for our research. After the literature review, we present a methodology for our own empirical study. Next, in the finding section, we will conduct a comprehensive analysis of the primary data collected for the purpose of this thesis, by comparing our findings with previous research. The final part will be devoted to the conclusion of our thesis, including: a general conclusion, the managerial implication of our research, followed by the limitation and suggestions for future research.

² Due to globalization and huge waves of migration, ethnic minorities in Europe are diverse (Wolff, 2009). Therefore, the European perspective of gender-ethnic diversity in STEM may differ or coincide with the American perspective.

Part II: Literature review

This part focuses on the existing literature to present what has been done by previous researchers. To better understand the topic, the literature review will be divided into two sections. Section one will focus on women in STEM; section two will address the issue of ethnic minorities in STEM by having an intersectional perspective.

2.1. Women in STEM

2.1.1. Definition of “STEM”

The acronym STEM stands for the four disciplines of Science, Technology, Engineering and Mathematics (Koonce et al., 2011) provided by the National Science Foundation (NSF) (Martín-Páez et al., 2019). Defining and classifying STEM’s disciplines is difficult since researchers and organizations all provide different definitions based on their own perspectives. **Table 1** shows an overview of disciplines commonly referred to in STEM education and occupation.

Table 1. Disciplines includes in STEM (own table based on Koonce et al., 2011)

STEM education	STEM occupation
mathematics, chemistry, computer science, biological sciences, physics, geometric analysis, and engineering, computer science, electrical, chemical and mechanical engineering	technology or science-related engineers, biological scientists, physicists, mathematicians, chemists, astronomy-related scientists, food-related technicians

The STEM movement started at the beginning of the 1990s. It was created to respond to the social needs of the US national academy of science, national engineering, and institute of medicine (Martín-Páez et al., 2019). According to the NFS, in 2007, students in the USA had low STEM competence compared to other countries. Still today, the number of people choosing STEM at university and careers in the US is lagging (Chen, 2015; Kelly, et al., 2013). Moreover, women, non-Asian minorities, first-generation students (i.e., the first members of their families to attend college), and those from low-income backgrounds leave STEM fields at higher rates than their counterparts do (Chen, 2015). It is thus no surprise that the US

Government was concerned for the future ability to compete in the global economy. This has led to various efforts to increase “the number and diversity of students pursuing STEM degrees and careers” (Chen, 2015, p.1).

2.1.2. Statistical evidence for a gender gap in STEM

Research conducted over the past decades shows the persistent **underrepresentation of women in STEM**. Indeed, few obtain a degree or pursue a career in STEM (Cole & Espinoza, 2011).

Regarding STEM **education** in the USA, we can see that at the **undergraduate** levels, 18,7 % had a baccalaureate degree in Computer Sciences, 19.3% in physical science, 20.9% in engineering, and 42.2% in mathematics and statistics (NSF,2019). In Europe, undergraduate female students in Informatics account for less than 35%. In Belgium, they represent less than 10% (Fatourou et al., 2019).

Focusing on **graduate** levels in the USA, 20.1% earned a doctorate in computer sciences, 19.3% in physical sciences, 23.5% in engineering and 28.5% in mathematics and statistics (NFS, 2019). In Europe, graduated women in information and communication technology (ICT) accounted for 36 % (Solis Pérez, 2019), 28 % in engineering, 40% in computer Sciences, and 22% in artificial intelligence. Likewise, in Belgium, graduated women in engineering accounted for 23.4 %, and just 9.9% of women graduated in ICT (RTBF,2019).

In terms of women’s participation in **STEM occupations**, when looking at the academia level, among the top 50 research universities in the USA, women held 31% of tenure track faculty positions (NFS, 2019). At the European level, 18% of women are employed in ICT (Solis Perez, 2019). In addition, professional women in STEM in the European Union constitute less than 25 % and only 14% perform research and operational tasks, including supervision and control of technical and operational aspects of engineering operations (Fatourou et al., 2019).

2.1.3. Causes of gender gap in STEM

So far, many studies in the scientific literature have used the “**Leaky Pipeline**” metaphor to explain the low number of women present in STEM fields (Cole & Espinoza, 2011; Grogan,

2019). The metaphor describes the educational conduit as “carrying students from secondary school through the university and on to a job in STEM” (Blickenstaff, 2005, P.369). Leaks refer to “cracks and gaps caused by the biases and barriers” (Grogan, 2019, p.3). In what follows, we will explain several of these biases and barriers. First, we present those at the early stage of the pipeline for female students. Next, we present those for women working in the STEM field. We distinguish between personal and contextual factors. A summary is provided in Table 2.

Table 2. Summary of barriers in STEM (own table)

	STEM education	STEM occupation
Contextual barriers	Cultural prescription for girls; stereotypes, campus culture/climate and classroom experiences, role models/mentors	Lack of role models/mentors; Masculine characteristics/institutional or corporate culture and climate; Stereotypes threats, faculty issues,
Individual barriers	Lack of motivation, lack of interest, Low grades in mathematics; affordability, Self-efficacy	Lower social capital; Motherhood roles

2.1.3.1. STEM education

Contextual barriers

Cultural prescription for girls

Historically, women were not encouraged to pursue scientific and technical education and occupations because of the cultural pressure to conform to gender traditional roles (Blickenstaff, 2005). In fact, for a long time, the willingness to build a family rather than pursue a career was accepted as an important and legitimate reason for the missing women in STEM occupations. Nevertheless, this idea has been criticized since it was only valid for young women with young children (Sassler et al., 2017). Moreover, when looking at family's contribution to mathematics gender stereotypes, Eccles & Jacob (1986) found that "mothers

felt that mathematics was more difficult for their daughters than for their sons and that mothers' beliefs about their children's difficulty in mathematics were strongly related to their children's mathematics anxiety" (Kahn & Ginther 2017, P.12).

Cultural climate and classroom experiences

Jensen & Deemer. (2019) discuss the impact a hostile and unwelcoming campus climate can have on female students in science disciplines, including a sense of alienation. They added that few research address the impact of a cold climate on female students' experiences in STEM. It was also shown that the presence of stereotypically geeky posters or magazines in a STEM classroom or laboratory setting would reduce women's interest and performance (Deemer et al., 2014). Still, regarding cultural climate, women of color faced the faculty's racial stereotypes about their academic ability. Thus, they were overlooked during different classes (Johnson, 2011). Female students of color reported feeling excluded and isolated in classrooms and laboratories as they were avoided by white students when they had to choose sitting places. (Johnson, 2007; Malone and Barabino, 2009; Ong, 2005; Tate and Linn, 2005 [as cited in Johnson, (2011)]).

Likewise, they did not have easy access to helpful information about classroom or laboratory work, scholarships and research opportunities.

Absence of role models

“Role models are individuals who provide an example of the kind of success that one may achieve, and often also provide a template of the behaviors that are needed to achieve such success” (Lockwood, 2006, p.36). Authors have argued that **the lack of role models** in science is another reason for the dearth of women in STEM. Blickenstaff (2005) justifies this by pointing out that the lack of women in science could lead young girls to believe that this field is not attractive to women. It could also signal women's inability to succeed in STEM fields (Herrmann et al., 2016), which would prevent female students from choosing a STEM major or thinking of a career in STEM fields (Blickenstaff, 2005).

Individual barriers

Researchers discussed individual factors preventing women from STEM. Gayles & Ampaw (2011) stated that high school performance in mathematics and sciences indicated success in the STEM field. Similarly, having **good grades** in high school (Griffith, 2010) and **parents**

having high incomes were positive predictors for declaring a STEM career goal (Cole & Espinoza, 2011). However, **a weaker academic background and a lack of motivation** were identified by Chen (2015) as barriers to STEM majors. Park et al. (2016) also found that women were more likely to show **worse mathematics performance and less interest** in STEM careers to seem desirable when pursuing smarter romantic partners on campus” (Blackburn, 2017, p.11). The lack of academic preparation is also a factor preventing girls from majoring in STEM (Blickenstaff, 2005).

Self-efficacy

Rittmayer & al. (2008) present **self-efficacy** as a key predictor of STEM performance and perseverance. They define self-efficacy “as the belief in one’s ability to perform a specific task” (Rittmayer et al., 2008, p.1; Tellhed et al., (2017) found that self-efficacy is an important mediator of gender differences in interest in STEM careers. Indeed, the low self-efficacy perceptions of female students about their Mathematics and Sciences competence is the reason why the latter often tend to leave the STEM field. Boys seem to be more confident about their math abilities and positively interpret their grades, while girls do not (Rittmayer et al., 2008).

2.1.3.2. STEM Occupation

Contextual barriers

Stereotypes threats

Stereotype threat is defined as “the social-psychological threat arising from a situation or activity for which a negative stereotype about the actor’s group applies” (Beasley & Fischer, 2012, p.3).

The underrepresentation of women in STEM was previously attributed to fewer women having advanced degrees. Still, this theory is no longer valid since statistics have shown an increasing number of women and minorities earning doctorate degrees (Griffith, 2010). In addition, the low number of women in STEM is, according to Rosser (2004), a result of disadvantages that women face, such as stereotypes and not merit. Stereotypes do not only deter women from joining STEM or make them abandon the field (Schuster & Martiny, 2017), but it also leads women to face **discrimination in hiring** and being offered **fewer promotion opportunities** (Casad et al., 2021). Casad et al. (2011) summarize the consequences of negative stereotypes:

reducing women's leadership aspiration, women feeling less competent and having a lower perceived acceptance, mental fatigue, and job burnout.

Likewise, STEM stereotypes are a decisive factor; the STEM field has always been perceived as **male-dominated**, with masculine characteristics more valued in the STEM department (Lester, 2008). People in the STEM field are seen as antisocial and technology geeks. Said stereotypes, transmitted by the media, role models and the environment, are seen as male attributes, incompatible with female gender roles (Drury et al., 2011). Women also face stereotypes regarding their **appearance and their behavior**. When the latter appear too feminine, it signals that they might not be suited for science (Banchefsky et al., 2016).

Institutional/ corporate culture and climate

According to the "Why So Few" report, the educational **environment** appears to be one of the most prevalent factors explaining women's underachievement and disinterest in STEM careers with academic context likely to exert an influence on women's success (Cole & Espinoza, 2011). Likewise, previous research has shown that the **chilly climate**³, **unfriendly and unwelcome environment** are the main reasons why women are absent and why most women abandon STEM fields (Casad et al., 2021). Females working in STEM fields report hostility and uncomfortable tensions in their work environments, such as **gendered microaggression** (McGee & Bentley, 2017), sexual harassment and discrimination. Still, they also experience tension, ostracism, and sexist behavior, leading to job dissatisfaction and an increasing desire to leave (Casad et al., 2021).

Previous research explains the non-achievement of tenure by women also included the lack of family-friendly employment policies such as paid leave and childcare (Beede et al., 2011). In one week, women with children are engaged for 101 hours dedicated to professional activities, housework, and caregiving activities; 35% of said hours are devoted to the caregiving mentioned above activities. Likewise, women also reported feeling tense or stressed in their parenting due to certain work activities (Mason & Goulden, 2004).

³ A climate is perceived as chilly "when individuals within an environment are not treated equally or fairly" (Seaton (2011) as cited in Blackburn's 2017, p.10).

Faculty issue

Researchers commonly assume that women tend to leave STEM fields more than men once they have acquired an academic career (Casad et al., 2021). Beede et al. (2011) looked at STEM degrees and careers by gender in their studies. They found that only 26% of women with a STEM degree pursue a career in STEM jobs because they are more likely to work in healthcare (McGee & Bentley, 2017). When conducting their research on the negative racial and gendered experiences that discourage academic career in engineering, Robinson et al., (2016) talked about the “female engineering experience” described by black female engineering students which involve characteristics such as a low number or a **complete absence of female engineering faculty members**. The authors reported no more than two full-time, tenure /tenure-track black female engineering faculty at the university where their interview was conducted.

Besides, women and especially women of color, often decide to shift or leave their STEM education and aspirations due to the **absence of faculty support** (Johnson, 2011). The latter reported being afraid of becoming faculty members for reasons including not being offered the opportunity to achieve senior status, plus the **competitive culture** that prevails in the engineering department preventing men and women from collaborating (Robinson et al., 2016). Indeed, Grogan (2019) found that women were underrepresented in publishing, funding, and hiring, and promotion to higher positions. The author did not only report that women submitted significantly fewer grants and fewer renewal grants than men to the national institute of health and NSF (30.7% versus 69.1% by men), but also that women are **less likely to receive professional awards** than men because of their low representation in the award pool.

When it comes to **teaching evaluations**, women are rated significantly lower than men, regardless of the gender of the student evaluator (Grogan, 2019). Still addressing the absence of faculty support, it has been revealed that extra burdens and higher expectations are placed on women by their faculty (Belle et al., 2014). In fact, they are the ones assigned to time-consuming tasks such as higher teaching loads and mentoring duties, resulting in said women having less time to conduct their research and publishing fewer articles. The **expectation to work on extra projects** seems to be common in STEM academia; However, working on extra projects limits the time available for family building or other life activities (Kachchaf et al., 2015)

Lack of role models/Mentors

Some popular media suggest that career success is due to having a good **role model** and that career failure can be due to a lack of role models. Individuals are encouraged to look for role models who can help them achieve their goals, and leaders of organizations are, in turn, encouraged to be role models for their employees. Indeed, women need more role models because they must face negative stereotypes regarding their competence at work. Thus, they need to identify themselves with other women who have succeeded in overcoming those negative stereotypes. Role models can be a source of positive inspiration by making future successes more tangible and showing how they can be achieved (Gibson, 2004). Similarly, the presentation of successful women in male-dominated fields can change the conception of the work itself and inspire other women to follow these fields (Heilman & Caleo, 2018)

Individual barriers

Lower social capital

The gender gap in STEM is also caused by women's **lower social capital** and less access to powerful social networks and interpersonal relationships (Casad et al., 2021). The lower social capital of women does not only impact relationships with co-workers and direct supervisors, but it also increases social isolation and decreases the ability to enter the STEM field (Casad et al., 2021). Likewise, Towns (2010) found that women had fewer career-advancing opportunities due to the **limited network exposure** and the fewer prestigious opportunities granted to them (Rosser & Lane, 2002; Walters & McNeely, 2010 [as cited in Casad et al., 2021]). Indeed, women collaborate less with each other than men who are 15% more likely to share when the request comes from another man. When it comes to publishing, "for high-impact journals, the likelihood a woman will be published as the first, last or corresponding author decreases significantly as the impact factor of the journal increases" (Grogan, 2019, p.3). In addition, women appear to be **less cited** in high-impact journal papers with women in key authors (35.2 citations per paper) compared to papers with men in key authors (38.9 citations per paper) (Grogan, 2019).

Motherhood roles

Researchers have presented **motherhood** as one reason behind gender inequality and a significant obstacle to women's careers. A woman's career progression is progressively reduced the more children she has (McIntosh et al., 2012). Women working in STEM's sector find it difficult to balance their family life with their careers, so some leave this field to start their

family life. Iwasaki (2015) mentions the practical realities of becoming a Scientist and staying in Science, including publishing enough high-profile papers to secure a postdoctoral position in a productive lab. On top of that, women scientists must excel in obtaining tenure.

2.1.4. Promoting gender and ethnic diversity in STEM

2.1.4.1. Importance of diversity in organizations

Gender disparity in STEM represents an economic issue and an ethical problem in our society. Different arguments are used to justify and promote gender diversity in STEM. On the one hand, there is a social justice argument promoting equal **opportunities**. UN members recognize equal opportunity as one of the UN Sustainable Development Goals (United Nations, s. d.).

Women represent half of the population, and the global economy would benefit from boosting their participation in the labor force (Fine et al., 2019). Having both men and women involved in decision-making broadens the perspectives, increases creativity and innovation, diversifies the pool of talents and competencies, reduces conflicts, improves the process of decision-making, and may better represent the firm's various shareholders (Profeta, 2017).

Various research studies the positive **effects of diversity on the performance** of an organization (Richard et al., 2004; Jackson & Joshi, 2003). Indeed, Kossek (2006) analyzes the effects of diversity on groups and concludes that the results of diverse teams are mostly better brainstorming, more global conclusions, and greater cooperation.

The ability of an organization to manage a diverse workforce is a **competitive advantage** and strength for the organization (Pattnaik & Tripathy, 2014). The aim is for firms to achieve a greater level of performance by becoming a heterogeneous organization in terms of employees and thus much more likely to cope with global issues (Harvey & Allard, 2014) and allow the organization to access specific markets (Pattnaik & Tripathy, 2014). According to the National Academy of Sciences (NAS), the increasing need for professionals in STEM fields will not be met without the participation of people of all racial/ethnic backgrounds and genders, potentially jeopardizing the United States' status as a global leader (Riegle-Crumb & King, 2010). Harvey & Allard (2014) add that the optimal diversity model is one of inclusion that reflects a much more **global population and economy**.

2.1.4.2. Best practices

A vast number of ongoing research on women's STEM experience address the need to attract and retain **women** in STEM by providing a wide range of solutions and recommendations that seem relevant and important to highlight. In what follows, we will explain a number of these solutions. First, we present those at the early stage of the pipeline for female students. Next, we present those for women working in the STEM field. A summary is provided in Table 3.

Table 3. Summary of solutions and recommendations to implement best practices in STEM education and occupation (own table)

	STEM education	STEM occupation
Solutions	Role of peer and faculty mentorship Use of role models Investing in teachers New communication channels funds to finance female-led projects Incentives ...	Antibias training for organizations Proactive recruitment measures Use of role models Mentoring initiatives Networking initiatives Family-friendly work policies ...

STEM education

Role of peer and faculty mentorship

Women's academic success could be achieved if they "are able to establish a rapport with faculty."Faculty members' respect and encouragement increase women's academic performance (Cole & Espinoza, 2011, p.52). Creating a diverse and inclusive academic environment "through learning activities, workshops, bystander interventions, dialogues, outreach, and equitable policies aimed at educating faculty about gender bias" is essential (Casad & al.,2021, p.1). A racial positive campus climate is associated with a sense of belonging for multiracial and minority women (Johnson, 2012).

Use of role models

The presence and the importance of role models have been addressed differently in much research. Indeed, some authors focused on the role model's importance in the major choice decision by investigating whether the presence of female faculty members was a trigger for female students' choices. Griffith's study (2010) presented a mixed result regarding faculty members serving as role models. On the one hand, she used the paper by Canes & Rosen (1995) to prove the absence of a link between the share of women on a department's faculty and the increasing number of female majors. On the other hand, she cited some peers, such as Robst et al. (1998). They found a correlation between the higher fraction of female instructors in Mathematics courses and the increased persistence of females in said major.

Although the impact of role modeling on female students' choice of major is controversial (Griffith, 2010), it has been documented by other authors that role modeling plays an essential role in attracting and retaining women and minorities in science (McGee et Bentley, 2017). **For female students majoring in STEM**, the intervention of role models is to prevent harmful effects of stereotype threat and prevent the said student from underperforming and leaving STEM fields (Drury et al., 2011). Likewise, interaction with role models may offer students and STEM employees the opportunity to pursue common goals in their educational and career paths (Fuesting & Diekman, 2017). A study on the gender and ethnicity matched of the role models and their audience shows that **minority female students** reported being encouraged to pursue STEM studies after being exposed to a STEM professional of the same ethnicity and gender (Kricorian et al., 2020). Lockwood (2006) found that having someone of the same gender as a role model facilitates identification since you might share apparent similarities.

Other initiatives

The European parliament also took several initiatives in 2019 to encourage young girls in STEM disciplines. Said initiatives included creating new channels to communicate with girls, setting EU funds to finance female-led projects in the digital sector, and investing in teachers to drive cultural changes (Solis Pérez, 2019).

STEM occupation

Anti-bias training of employers and supervisors

Research highlights the importance of **training employers** on subtle **unconscious biases**⁴ (Lubin, 2014) and **cognitive biases** to prevent discrimination in hiring and promotions. While it is helpful to provide anti-bias training to employees to raise awareness and establish strategies, it seems that training needs to be supported by **structural changes** to be more effective (Carter et al., 2020).

Proactive recruitment of women in STEM occupations

There is a clear need for **institutional support** to address gender inequality in STEM, particularly when it comes to hiring women. Companies and academia need to **modify their recruitment efforts** to reach a diverse group of candidates (Beasley & Fischer, 2012). Studies have also shown a gender disparity in information sources, with employers typically relying on existing employees' social networks when recruiting, thus producing the existing gender composition of the department. Therefore, to prevent this phenomenon, it is essential to emphasize the importance of **reaching out to neglect social networks** by advertising jobs in non-traditional venues, including advertisements explicitly targeting women, thereby increasing the number of female applicants (Glass & Minnotte, 2010).

The use of role models in STEM occupations

With women experiencing difficulties in overcoming the **glass ceiling in the male profession**, it is more than a need for them to have **professionals like them** who have been able to succeed in their careers to serve as an example. It has been proven that female models who have been successful in their work might serve to overcome negative gender stereotypes (Lockwood, 2006). In addition, the likelihood of women persisting in STEM was high after reading a letter of encouragement from role models (Herrmann et al., 2016). In its effort to promote gender equality in STEM, the European Parliament also spoke of **increasing female role models' visibility to boost girls' self-confidence in digital skills** (Solis Pérez, 2019).

However, unlike Lockwood's studies (2006), Drury et al. (2011) observed that the gender of the role model has no impact on the recruitment of women in STEM. In fact, they argued that male role models are just as effective as female ones in recruiting women in STEM.

⁴ Heilman & Caleo (2018, p. 729) mentioned that training on unconscious biases involves 'raising awareness of implicit stereotypes and prejudices, with the aim of reducing the automatic associations they may have'.

Researchers have been particularly interested in analyzing **the circumstances where role models are likely to inspire** their audience. When addressing the importance of role models in the literature, it appears that role modeling could be more effective in retaining women in STEM than in recruitment (Drury et al., 2011). The authors explained that "the psychological threats that prevent recruitment are different from those that prevent retention" (p.266). In addition, they used the example of negative stereotypes, which are less of a concern for women who do not yet identify with the domain than they are for STEM-identified women.

Mentoring and networking initiatives

Mentoring has been cited in previous research as one of the main factors for attracting and retaining women in STEM (Phume & Bosch, 2020). Mentors provide psychological support through advice, encouragement, and friendship to help their students or colleagues develop their professional identity and confidence (Kram & Isabella, 1985 [as cited in (Quinlan, 1999)]).

In addition, both male and female mentors are valuable. Female mentors provide emotional support and advice, as they seem to be more caring and protective. On the other hand, men are useful in providing professional support by exposing their protégés to good networks and challenging assignments. Several articles have explicitly focused on the gender of the mentor, stating that same-sex pair is more advantageous than an opposite-sex pair (Lockwood, 2006). The **theory of gender and ethnicity matching in mentoring** has also been argued by other authors who found no difference in the psychosocial support provided by a same or different gender mentor (Ensher et al., 2002; Ensher & Murphy, 1997 [as cited in Lockwood, 2006]). Furthermore, mentoring appears to be the primary action taken by the US institutions and organizations to increase and support women in STEM, particularly at the university level (Beasley & Fischer, 2012). In examining mentoring and the success of their protégés (Ma et al., 2020) discovered that mentoring helped protégés succeed; however, the best outcomes of mentoring are more likely when students move away from their advisor's research agenda and chart their own research course.

Retaining women in STEM also requires **networking and professional development**. As mentioned earlier, women are disadvantaged in professional socialization due to their limited exposure to networks (Casad et al., 2021). Thus, **promoting women's networks** among faculty

is useful for actively recruiting candidates and increasing women's access to information regarding administrative support and advancement opportunities (Xu & Martin, 2011).

Initiatives in Europe

Lastly, at the European level, the European parliament took several initiatives in 2019 to promote gender diversity in STEM, such as: providing incentives, putting in place pay transparency policies, better maternity leaves and flexible working hours (Susana, 2019).

2.2. An intersectional perspective on women in STEM

2.2.1. Definition of intersectionality

Intersectionality was first formalized as a **paradigm** by Hill-Collins (1948) and popularized in the late 1980s by Kimberlé Crenshaw (1991). American and other researchers in many disciplines, such as social sciences or gender studies (Carbado et al., 2013; Crenshaw, 1991), have widely disseminated ideas and theories of Intersectionality. This movement initially originated in the American Black Feminism movements, which aimed to critique the monopoly of **white middle-class women** in feminist discourses of the time (Duros, 2014). Politikon (2020) mentioned that this demonstrated the invisibility of black American women in both the anti-racist and feminist struggle.

Several authors have defined the concept of Intersectionality. However, we will retain that of Hill-Collins & Bilge (2016), who defines it as follows:

Intersectionality investigates how intersecting power relations influence social relations across diverse societies as well as individual experiences in everyday life. As an analytic tool, Intersectionality views categories of race, class, gender, sexuality, class, nation, ability, ethnicity, and age -among others- as unrelated and mutually shaping one another. Intersectionality is a way of understanding and explaining complexity in the world, in people, and human experience" (Collins & Bilge, 2016, p. 12).

In other words, Metcalf et al. (2018) complement this definition by expressing Intersectionality as "a well-established contextual framework for examining the complex ways in which multiple systems of oppression deeply intertwine to influence experiences and opportunities"

(p.582). Crenshaw (1991) emphasized the importance of accurately defining the intersections faced by racialized women because of their gender and race while at the same time pointing out that Intersectionality based on these two criteria was not the only cause of violence against women of color (Vergès, 2020). Intersectionality is, therefore, a tool that allows us to highlight that a person can be subjected to several types of oppression simultaneously.

Intersectionality is a powerful analytical tool (Sibbett, 2020) as, according to Falcon & Nash (2016), "*the first theoretical, political, and epistemological concept developed by women of color to have profound resonance in the academy*" (p.2). However, it is a concept criticized within the literature in the way researchers use it (Sibbett, 2020). Nash (2019) refers to it as the '**Intersectionality war**' to describe the multitude of uses of interpretations made in the literature.

More and more research has been conducted focusing on only one type of inequality (i.e., gender, class, race, age). The **literature on gender** began in 1960, but inequality persists despite the wealth of research (Acker, 2012). However, few studies simultaneously focus on different social factors (Acker, 2012). There is no exception in STEM. Although more complex and challenging to implement due to the difficulty of collecting data (Feskens et al., 2006), Intersectionality has become a framework that is increasingly applicable to the STEM field (Metcalf et al., 2018).

2.2.2. *Statistical evidence for ethnicity/racial gap in STEM*

2.2.2.1. **Definitions: race and ethnicity**

Discrimination and difference in treatments are still significant issues in STEM. Disparities in terms of race and ethnicity have always been an issue in education, training and employment-related to STEM (Funk & Parker, 2019)

Scholars generally agreed that in terms of race and ethnicity, the STEM environment was predominantly dominated by White men (Riegle-Crumb & King, 2010). According to recent data from the APPG on Diversity and Inclusion (2020), the percentage of White men reached 65% in the STEM workforce.

Race and **ethnicity** are concepts that are connected but remain different. While those concepts differ, they both represent social constructs used to categorize and characterize distinct populations (Blakemore, 2019).

The Myriam-Webster’s dictionary defines race as “a category of humankind that shares certain distinctive physical traits.” Ethnicity is defined as follow: “large groups of people classed according to common racial, national, tribal, religious, linguistic, or cultural origin or background.”. While the concept of race is narrower and based on biological attributes, the concept of “ethnicity” is based on the place of origin and the cultural expression (Morin, 2020).

2.2.2.2. The ethnicity gap in STEM: some data

In **Europe**, the debate over collecting statistics regarding ethnic-racial characteristics is still on the table⁵ (Renault, 2021).

In the **United States**, ethnic-racial data are frequently collected and used. The United States Census Bureau categorizes the different ethnicities and races within the US population with several terms (US Census Bureau, 2022): Black or African American, Hispanic⁶, White, Asian, Native Hawaiian, or Other Pacific Islander. Table 5 shows the different categories and regions of origin considered for each ethnicity or race.

Table 4. Region of origin considered for each race/ethnicity in the USA (Table based on United Census Bureau, 2022)

White	Black or African	American Indian or Alaska Native	Asian	Native Hawaiian or Other Pacific Islander
Europe, Middle East, North Africa	Sub-Saharan Africa	North America, south America, Central America	Far East, Southeast Asia, Indian	Hawaii, Guam, Samoa, Pacific Island

⁵ While countries like the Netherlands or the United Kingdom are actively censusing their population, in France it is still subject to interrogation (Renault, 2021).

⁶ Hispanic or Latino is not considered as any race but as an ethnicity according to the US Census Bureau.

STEM Education

Studies show that despite an increase in the number of students graduating in a science major, from 24% to 27% between 2000 and 2019 (Fry et al., 2021; Hale, 2022), ethnic minority students are still underrepresented.

Between 2008 and 2018, the number of **Black students in STEM** remained relatively stable at 8%. However, the number of degrees awarded to African American students increased by 35.9% in that same period (Hamrick, 2021). However, the numbers show a disparity in the different STEM fields, with some decline in the representation of black students in computer science.

In 2018, the proportion of **Hispanic college graduates** with a STEM degree (12%) remained lower than all college graduates (15%) (Fry et al., 2021).

Compared to their share of all college graduates in 2018, **Asian** and **White** students continue to be overrepresented among STEM college graduates. Other racial groups, such as **Native Americans, Native Hawaiians, Pacific Islanders**, and those who identify with two or more racial groupings, are getting bachelor's degrees in STEM at roughly the same percentage as all degree recipients (Fry et al., 2021).

STEM workers are about twice as likely as other workers to have earned a bachelor's degree or more education (67% vs. 34%) and roughly three-quarters of these workers hold a degree in a STEM field.

STEM Occupation

Diversity in the workplace is crucial for American policymakers and, most specifically, American companies' competitiveness in STEM-related fields (Alfred et al., 2018).

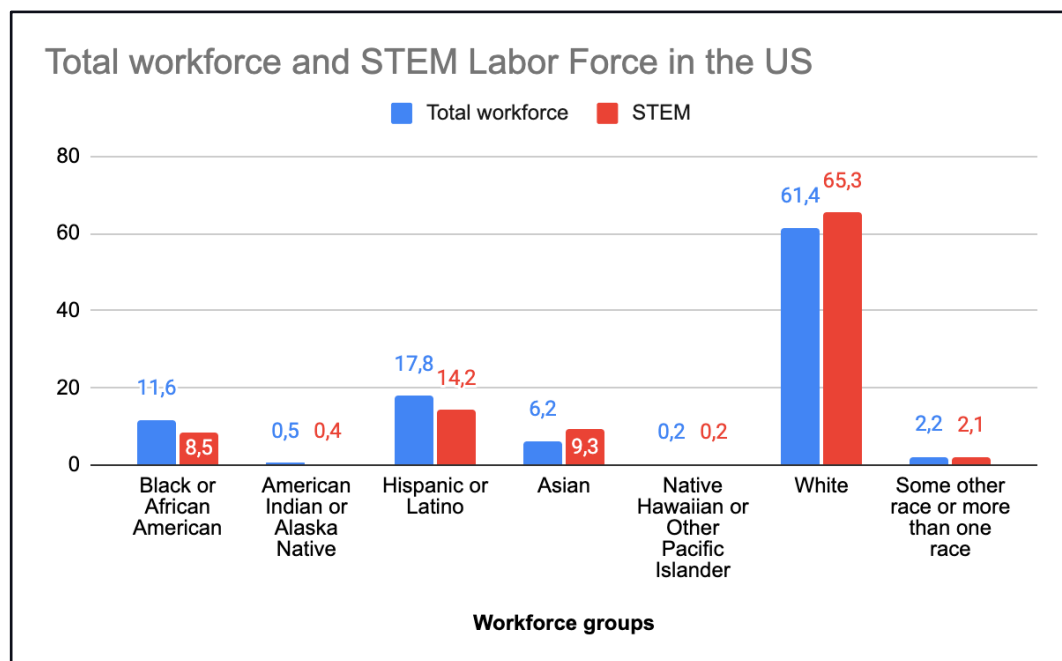
The National Scientific Board (NSB) of the NSF studied workers' participation **in STEM occupations** based on their sex, race and ethnicity in the US population (Fry et al., 2021).

According to data from 2021, **White workers** remain the majority group present in the STEM occupation (65%) regarding their general presence in the US workforce (61%), followed by **Asians** present in more than 9% in the STEM workforce compared to their overall presence

within the US workforce (6%). Despite their overrepresentation, the number of White workers has declined since 2016 overall occupations (Fry et al., 2021).

Hispanic workers represent 18% of the US total workforce but represent only 14% of STEM workers, while **Black workers** represent almost 12% of the US workforce but only 8,5% of STEM occupations. Figure 1 highlights the underrepresentation of Black and Hispanic workers in STEM occupations.

Figure 1. Total workforce, STEM labor workforce in the US (Table based on the National Scientific Board, 2021)



2.2.3. Statistical evidence for a gender and ethnicity gap in STEM: the intersectional approach

STEM Education

Despite their high level of education, women in STEM remain underrepresented and occupy the lowest level in the organizational hierarchy (Casad et al., 2021). In addition, ethnic minority women face an **intersectional problem** of **gender and racial stereotyping**, which is fully amplified by the stereotypical perceptions of others (Kamenou & Fearfull, 2006).

Even though the presence of ethnic minority women in science studies is improving, they are still underrepresented in the various majors, the underrepresentation within these groups

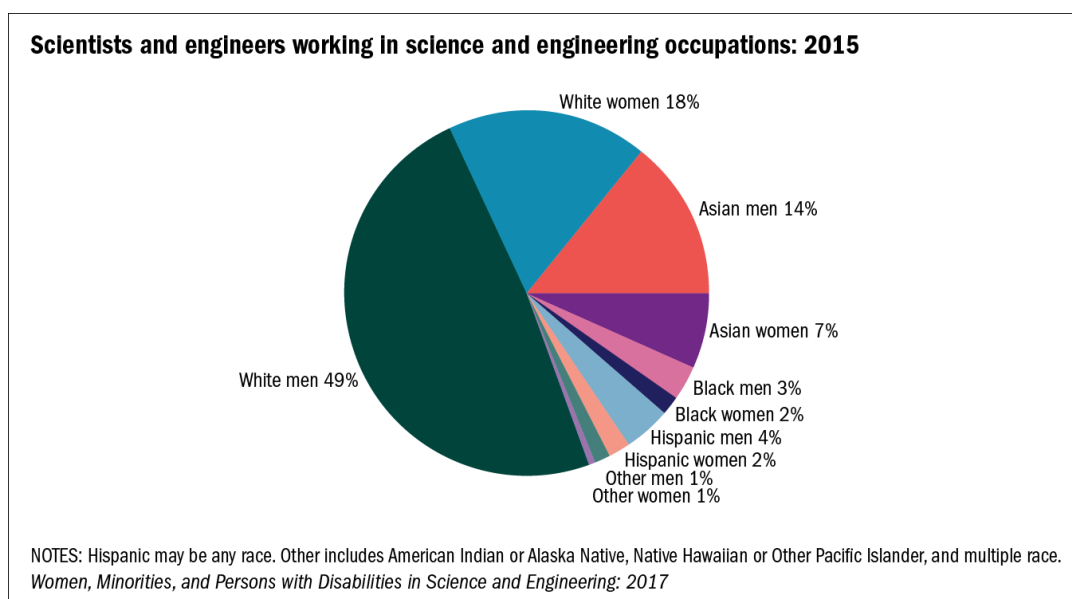
remains the norm (Fry et al., 2021). The participation of groups within ethnic minority women in STEM fields is not proportional to their representation in the US population (Hamrick, 2021). Compared to their representation at the overall population level, ethnic minority women ages 18–24 years old make up 21.9% of the population and ethnic minority women ages 25–64 make up 18.8% of the population (Hamrick, 2021). **Hispanic women** ages 18-64 make up 8% of the population, **Black women** make up 7% of the population, and **Asian women** make up 3%.

Women of ethnic minorities make up 4,8% of IT graduates and 5,4% of maths graduates and 13,3% of first-cycle science and engineering graduates and just 10% of doctorate graduates in science and engineering. The numbers related to STEM enrollment and degree completion illustrate the underrepresentation of Black, Latinos, and Indigenous women in STEM fields, especially in mathematics, engineering, computer science, and at the most advanced education levels.

STEM Occupation

Data from the 2017 NSF report (National Sciences Foundation, 2017) captures the gender and ethnic/racial breakdown in STEM occupation. Figure 2 summarizes the data collected in 2015.

Figure 2. Scientists and engineers working in science and engineering occupations: 2015 (Figure based on NSF report, 2017)



Ethnic minority women (black women, Asian, Hispanic women) accounted for only 12% of professionals in STEM fields. Of this 12%, Asian women represent 7%, Black women and Hispanic women represent 2% and finally, those from other ethnic minorities represent 1%.

In comparison, their white peers represent 18% of the STEM workforce in the 2015 statistics. The numbers show that white males remain the majority represented within STEM occupations.

2.2.4. The role of racism in the careers of ethnic minority women

The research highlighted the underrepresentation of women, most specifically women from an ethnic minority background in organizations compared to men and people from the ethnic majority (Powell, 2007). This societal problem is also confirmed by research in the STEM field (Syed & Chemers, 2011). However, Feskens et al. (2006) recognize the gap in the literature on the career evolution of ethnic minority women in STEM. Ethnic minority women face double discrimination due to their ethnicity and gender in many fields and organizations, of which STEM is a part. The literature acknowledges the structural racism⁷ faced by ethnic minority women in STEM (McGee et Bentley, 2017).

2.2.4.1. The marginalization of ethnic minority women in STEM Education

From their first steps within the field of science until graduating from higher education, minority female students face barriers. During their studies, racialized women do not feel like they belong in the scientific community due to the many **stereotypes and preconceived notions** around STEM. On the one hand, according to Miyake et al. (2010) research, STEM would be perceived as a **white male-only field**, which sends an exclusionary message to women who question their skills and abilities in these fields (McGee & Bentley, 2017). Therefore, feeling unwelcome and given the lack of peers around them, female students from underrepresented groups **drop out of science majors** more easily than other ethnicities (Alfred et al., 2018). On the other hand, ethnic minority women are doubly penalized as they are often the **only racialized women** in their environment, which marginalizes them from the

⁷ According to Bonilla Silva (1997), structural racism is defined as: “systemic and foregrounds the reality of the United States' racialized systems, wherein economic, political, social, ideological, and educational dynamics routinely advantage Whites while producing chronically adverse outcomes for, nondominant racial and ethnic groups.” (McGee & Bentley, 2017)

group (Kachchaf et al., 2015). The lack of racial and ethnic diversity in STEM faculties implies fewer racial and ethnic groups of peers providing social support and counseling (Johnson, 2011). The statement about the poor support from the faculty was also validated by Malone & Barabino (2009). They added that **black women receive little help and support** in completing their research and are often not recommended by the faculty for internships or awards.

Furthermore, while scholars acknowledge the lack of role models for women (Herrmann & al., 2016; Blickenstaff, 2005), which has a positive influence on the retention of women in STEM, ethnic minority women face even less representation than their white peers (Alfred et al., 2018). This can cause minority female students to develop an **imposter syndrome** that would cause them to leave STEM (Hinton et al., 2020). Kricorian et al. (2020) provide more insights into the views and experiences of ethnic minority students actively pursuing STEM studies. They found it essential for underrepresented students to meet and be mentored by people of the same gender and ethnicity. Promoting diversity in mentoring helps strengthen the sense of belonging to STEM.

2.2.4.2. The experience of ethnic minority women in STEM Occupation

The significant underrepresentation of women of ethnic minorities in various STEM work environments exacerbates and intensifies their negative experiences, leading to their disinterest in scientific fields (Casad et al., 2021). Ethnic minority professional women face several barriers. Liu et al. (2019) categorized them into three major barriers: Barrier to Selection, Barrier to Retention, and Barrier to Promotion.

Barriers to Selection

Recruitment bias is a significant barrier to attracting ethnic minority women into STEM. According to the STEM Return Index, 43% of women surveyed believe they have experienced recruitment bias related to their race/ethnicity (*The Index 2021, 2022*). A study conducted by Quillian et al. (2021) shows that black women experience the most discrimination in hiring due to the intersection of factors such as gender and ethnicity. Although sometimes unconscious, racial biases can remain with recruiters in their choice of candidates (Quillian et al., 2021). Additionally, these stereotypes are unique and only experienced by ethnic minority women

(Ashley,2014). Sometimes, these biases are directly associated with skin color or ethnical backgrounds, such as the name, skin color, and body characteristics.

The study highlights affirmative action's positive impact on these ethnic minority women experiences (Quillian et al., 2021). It gave them access to more opportunities. However, Dover et al. (2016) highlight that targeted recruitment as an isolated action can lead to opposite reactions from those desired by the majority.

Barriers to Retention

Ethnic minority women also experience more **discrimination and aggressions** in the workplace. Those aggressions could also take the form of microaggressions⁸. According to the Pew Research Center (2020) report, ethnic minority workers in STEM are more likely to admit to having experienced discriminatory workplace insults based on their ethnicity or race at 62% for Black workers, 44% for Asians, and 42% for Hispanics versus 13% for Whites. Marshall et al. (2021) show that ethnic minority women face several types of aggression: micro-disabilities, micro-insults, and micro-assaults (Sue et al., 2010). The discrimination can take the form of sexism and racism in the case of ethnic minority women (Ashley,2014).

Workplace microaggressions stem from a **hostile work environment** to ethnic minority women, which would lead to a greater likelihood of **dissatisfied workers** leaving STEM (Miles et al., 2021). Conversely, a healthy and positive work environment will drive women to persist in STEM (Lahti, 2018).

The lack of similar peers in their department hinders ethnic minority women's progress in STEM. Indeed, Mckinsey's report for Diversity and Inclusion 2021 highlights the influence of being the only racialized person in their work environment reinforces isolation and social exclusion.

Ethnic minority individuals experience what researchers have termed **impostor syndrome**. The phenomenon is defined as follow (Kolligian Jr. & Sternberg ,1991 [as cited in Bravata et al., 2019]):

⁸ Racial **microaggressions** are inappropriate comments based on a variety of racial preconceptions regarding criminality, intelligence, cultural values, and citizenship, as well as the minimizing or denial of people of color's racialized experiences (Miles et al., 2021).

Impostor syndrome (...) describes high-achieving individuals who, despite their objective successes, fail to internalize their accomplishments and have persistent self-doubt and fear of being exposed as a fraud or impostor. (p.1252)

Imposter syndrome affects students and professionals alike (Chakraverty, 2019). Research has shown that women are not the only people affected by this phenomenon (Navarre, 2020), and it affects all genders and ethnicities in all professions (Chakraverty, 2019).

The impostor phenomenon exacerbated stress, performance anxiety, loss of confidence, burnout, emotional instability, and a sense of belonging (Burt et al., 2017).

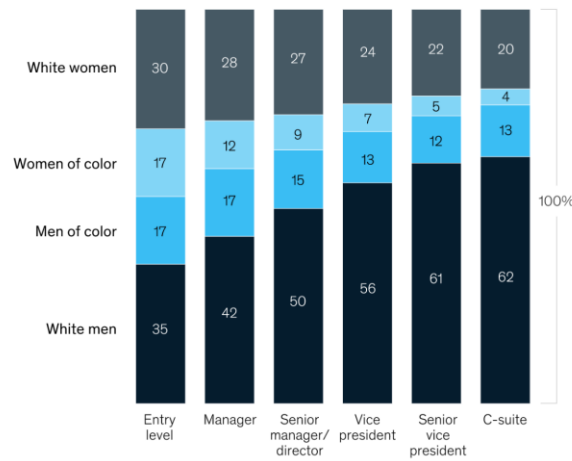
In order to combat these barriers, organizations must focus on the implementation of **follow-up** and **mentoring programs** and emphasize social interactions between employees to eradicate the feeling of alienation and isolation (Liu et al., 2019).

Barriers to Promotion

Ethnic minority women face the same barriers outlined in the first part of this literature review. Concerning their career development, all the above barriers are factors of stress, alienation, and isolation for ethnic minority women. However, ethnic minority women experience specific career development barriers within organizations, as they are **underrepresented in leadership positions**. Despite accounting for half of the workforce, women only make up a quarter of the executive suite (Burn et al., 2022). Figure 2 represents the disparity of top management in the U.S. labor market. Only 4% of ethnic minority women are in top management positions compared to 62% of their male counterparts.

Figure 3. Representation by corporate role, gender and race (figure based on McKinsey & Company report, 2021)

Representation by corporate role, by gender and race, 2021, % of employees



Note: Figures may not sum to 100%, because of rounding.
Source: Women in the Workplace 2021, LeanIn.Org and McKinsey, 2021

McKinsey
& Company

In addition, research shows a **wage gap** between women and men in STEM fields, which is an additional barrier when women consider their career development. According to data from the Pew Research Center (2018), ethnic minority women in STEM earn much less than their White peers. For example, black women make 87% of what white women earn and 62% of what white men earn. Hispanic women make roughly 85% of what white women make and 61 % of what white men make.

Part III: Methodology

3.1. Purpose of the qualitative analysis

To answer our research questions and analyze the trajectory of women in STEM by comparing experiences from ethnic minorities' perspectives and White women's perspectives in education and professional careers in STEM, we conducted a **qualitative methodology**.

The purpose of conducting a qualitative analysis is to collect sufficient data to make some inferences, identify some patterns and similarities among women and points of divergences between the different profiles. Qualitative research attempts to assess participants' views of their own social world without making value judgments during data collection (Sofaer, 1999). In addition, qualitative research can be useful in developing new social theories about unknown topics or issues, thus generating hypotheses that can be tested.

This approach allows each respondent to describe their perceptions and experiences and determine what barriers they have faced. Interactions between respondents and interviewers are crucial to provide in-depth analysis and improve the answers' quality. All our analyses will be presented in the findings and compared to the literature.

3.2. Data collection

Method

Sekaran & Bougie (2016) present several data collection methods in their book. However, we have decided to **conduct interviews** for our thesis since this method appears to be very popular in business research and allows the researchers to collect a broad range of information from different human respondents (Sekaran & Bougie, 2016). We conducted **online semi-structured interviews**. First, semi-structured interviews are best suited to allow each respondent to express their opinion and perception regarding this sensitive issue (Barriball & While, 1994). Second, it provides spaces for clarification from both sides regarding a question or an answer. Finally, regarding our heterogeneous sample, using semi-structured methods enabled us to ask specific questions based on the profile of each respondent, using different interview guidelines according to the respondent's group. We conducted online interviews because it was the most convenient way for our respondents, given their respective occupations, and also because one of us was on an internship abroad.

To reach various types of profiles for the respondents, we used different networks. For professionals, we used our network but also LinkedIn. We mainly contacted our contacts and posted messages on the different Facebook groups for students. **Word of mouth** was the most successful method as it allowed for the largest possible number of respondents. For professionals in STEM occupations, we first searched for companies active in STEM, then we contacted a reference person in the company asking him/her to share our mail internally. **LinkedIn** has proven to be very useful for contacting professionals. At the end of each interview, we also asked our respondents if, from their side, they had contacts that we could potentially reach. This method allows us to get both more students and professionals.

Sample

To better understand and analyze the role of ethnicity and gender criteria in determining women's career trajectories in STEM, we extended our focus to **25 various profiles**. On the one hand, we collected data from **undergraduate and graduate students** to obtain their testimony about their student journey through higher education in a STEM-related field. Of the 25, twelve are college students, two are ethnic minority males, two are young white female students, and the last eight are ethnic minorities. On the other hand, we interviewed thirteen professionals in STEM occupations to determine how their trajectories evolved compared to students. Of the 13, we interviewed two ethnic minority men, five ethnic minority women, and six ethnic majority women. (see table 5). Due to the geographical distance (internship abroad for Elisabeth) and in the context of the COVID19 crisis, we only conducted online video interviews. In addition, it was important for us to be fully immersed in the subject, so we decided to conduct as many interviews as possible between the two of us. Due to various factors, some interviews had to be conducted by one of us and in this case, the other would transcribe it in order to have the same information for both of us.

Table 5. Overview of respondents interviewed (own table)

Female students												
respondents	Fake Identity	Age	study /Major	Ethnic minority	Origin	Education level	School	Online / Physical	date/ Time	Timing	number of Pages	interviewer
1	Chloé	22	physics	NO	Belgian	Master	UCLouvain	Online	25/03/2022 - 7 pm	44min	13	Both of us
2	Sophie	22	Civil Energy Engineer	NO	Belgian	Master	UCLouvain	Online	25/03/2022 - 1pm	50min	12	Elisabeth
3	Magnolia	25	Bachelor in electromechanics	YES	Cameroon	Bridging program	iepsfc	Online	20/03 / 2022- 7:30 pm	52min	6	both of us
4	Nadia	25	Chemical Process Engineering	YES	Cameroon	Master	VUB	Online	16/03 / 2022- 8:30 pm	60min	11	both of us
5	Kiana	24	Industrial Engineer	YES	Cameroon	Bachelor	Ecam	Online	22/03 / 2022- 7 pm	52 min	11	Syndia
6	Isabelle	21	Civil Engineer	YES	Morocco	Bachelor	ULB	Online	18/03 / 2022- 7:30 pm	52min	9	Both of us
7	Mélanie	23	Civil Engineering	YES	Vietnam	Master	UCLouvain	Online	16/03 /2022- 7 pm	53min	11	both of us
8	Elena	22	Computer Science	YES	Belgian/Thai	Master	UCLouvain	Online	26/03/2022- 10 am	56min	16	both of us
9	Stephanie	23	Civil Engineer	YES	Congo/Spanish	Master	UCLouvain	Online	1/04/2022 - 1 pm	33 min	8	Elisabeth
10	claudia	25	Industrial Engineer Health Option	YES	Cameroon	Master	Ecam	Online	02/04/2022 - 8 pm	53min	10	both of us
Male Students												
respondents	Fake Identity	Age	Study/Major	Ethnic minority	Origin	Education level	School	Online / Physical	Date/ Time	Timing	Pages	interviewer
11	Adrien	25	Civil Engineer Electrician	YES	Cameroon	Master	UCLouvain	Online	08/04/2022 - 1 pm	40min	7	Both of us
12	Pierre	23	Civil engineer	YES	Congo	Master	UCLouvain	Online	10/04/2022 - 11 am	45 min	9	elisabeth
Professional Women												
Respondents	Fake Identité	Age	profession	Ethnic minority	Origin	Company	number of years in the company	Online / Physical	Date/ Time	Timing	Page	Interviewer
13	Anne	24	Civil Engineer - PhD	NO	Belgian	UCLouvain		Online	19/03/2022 - 2pm	54 min	13	Elisabeth
14	Sara	24	Bioengineer - PhD	NO	Belgian	UCLouvain	year 3 Month	Online	23/03/2022 - 7:30 pm	60min	11	Both of us
15	Sabine	59	IT consultant	NO	Belgian	NSI	10 years	Online	30/03/2022-7pm	46min	10	Syndia
16	Susane	38	Civil Engineer - Architect	NO	Belgian	Sweco	7 years	Online	30/03/2022 - 8 pm	43min	9	Syndia
17	Leonor	30	Developer (IT)	NO	Belgian	Delaware	8 months	Online	01/04/2022 -7 pm	33 min	8	Elisabeth
18	Aylin	26	Industrial engineer in chemistry	YES	Turkish	seeking for a job		Online	21/03/2022 - 8:30 pm	50min	10	Both of us
19	Marie	26	Industrial engineer in chemistry	YES	Turkish	UCB Pharma	8 months	Online	28/03/2022 - 8 pm	49 min	11	Both of us
20	Jeanne	30	Engineer architect	YES	Congo	Self-employed	8 months	Online	04/04/2022 - 6:30 pm	49min	7	Both of us
21	Eva	36	Chemical Engineer	YES	Iran	seeking for a job		Online	8/04/2022 - 6:30 pm	30min	6	Syndia
22	kayla	27	Information Systems and Network Engineer	YES	Algeria	Delaware	6 Months	Online	05/04/2022-7:30 pm	59min	12	Syndia
23	Juliette	35	Engineer architect	NO	Belgian	Cocom/Brussels	6 years	online	23/04/2022- 4pm	49 min	9	Syndia
Professional MEN												
24	Didier	27	Computer Science - AI - PhD	YES	Congo	VUB	3 years	Online	27/03/2022- 10 am	74min	12	Elisabeth
25	Jonathan	27	Computer Science	YES	Syria	By Way	5 years	Online	10/04/2022 - 7:30 pm	45 min	12	Elisabeth

As we wanted to highlight the different experiences between white women and ethnic minority women, it was relevant to gather both perspectives on the topic to compare and obtain relevant findings. Furthermore, we also included ethnic minority men (students and professionals) to understand how their experience differs or coincides with female peers. Following the standpoint theory as mentioned by Ross et al. (2020), the involvement of ethnic minority men in this research is not intended to eclipse the women's testimonies but to compare experiences between groups close to those of ethnic minority women.

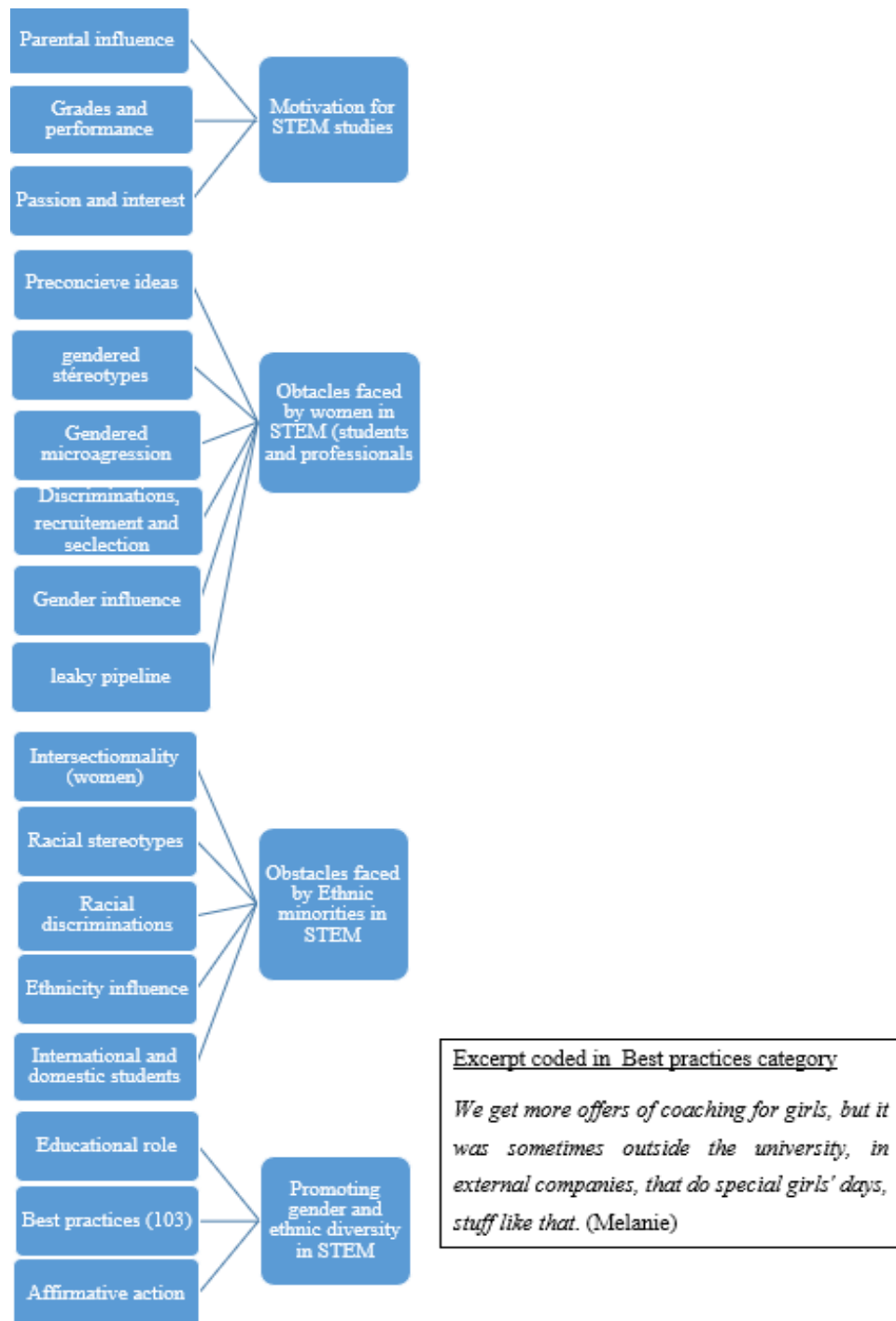
All our respondents were either studying or working **in Belgium** since the scope of our research focuses on the experience of Europeans, and more specifically, ethnic minorities women active in Belgium, for their studies or career.

3.3. Data Analysis

Once we conducted our interviews, we followed the methodology Miles & Huberman (1994) outlined, divided into three points: data reduction, data presentation, and concluding our analyses.

In order to reduce our data, we used a hybrid approach. First, we classified the data according to the categories we had discovered in the literature to make a first classification. Then, after the first complete coding of our interviews, we studied the codes that could help us find an answer to our research question and sub-questions in depth. Seventeen categories emerged after the coding processing: gender influence, ethnicity influence, intersectionality, discrimination and microaggressions (sexist, racist and others), grade and performance, passion and interest, stereotypes and preconceptions, recruitment and selection, leaky pipeline, family status influence, parental influence, educational role, affirmative action, best practices, international students, and domestic students. Finally, we went back to our literature review to compare our data and see how they converged or diverged from our initial assumptions and draw our conclusion based on that. Figure 4 shows an overview of our coding tree.

Figure 4. Our coding tree (own figure)



3.4 Self-reflexivity

Although we are both concerned and affected by the field of intersectionality, we have tried to question and challenge our own biases. However, we are both aware that our way of perceiving

and interpreting data is more sensitive due to our "proximity" and the situations experienced by ethnic minority women. This does not call into question the impartiality and distance we have tried to take in the analysis and writing of this thesis.

Furthermore, from the beginning of the interview, we spent some time putting our interlocutor in a climate of confidence. This was felt throughout the interviews, as many of them shared with us that they were expressing themselves on this topic for the first time and felt it was necessary because no one had ever asked them about it. We believe that our status as ethnic minority women allowed us to connect more easily with the interviewees, whether they were white women or racialized people.

However, this does not take away the fact that this is still a sensitive topic and that we had to take much distance and be very careful not to offend people's sensibilities.

Part IV: Empirical findings

This section presents our findings in two main parts: The first part looks at students' experiences in STEM, including white and ethnic minorities. The second part focuses on the experiences of professionals in the STEM fields. Since the professionals were also students at some point, we thought it would be interesting to consider their own past experiences when discussing students' experiences in STEM studies.

4.1 Findings related to STEM education

This part focuses on the barriers female students face in STEM, including ethnic minorities, to understand how different both experiences are. We will then delve into the actions and practices implemented by Belgian universities and schools to attract and retain female and ethnic minority students in STEM.

4.1.1 Obstacles to gender and racial equality in STEM education

Previous research mentioned different barriers and obstacles preventing girls from studying in the STEM domain (Deemer et al., 2014; Ong et al., 2011). During our interviews, we were able to list the obstacles ethnic majority female students and ethnic minorities face during their studies. We started by looking at common barriers between white female students and ethnic minority female students. Next, we listed obstacles mentioned exclusively by ethnic minority students.

4.1.1.1 Obstacles mentioned by female STEM students

We first present several contextual barriers related to gender, within STEM education, at the contextual level of the academic environment or society. After this, we mention three more individual-level obstacles female students experience in STEM education.

Discouragement from teachers/professors

Girls who choose science options from secondary school are exposed not only to negative remarks and comments from teachers, but some are even “**discouraged**” from following this path in higher education. The following two respondents explain how their teacher did not have much faith in them as young girls interested in science. Consider the following two excerpts:

I remember one of my teachers in the 4th year of secondary school saying to me: You will never be an engineer. It is a stupid sentence, but I have remembered it all my life.
(Stephanie)

I arrived in class the first week of the school year, and on the first day, the teacher asked me: "Did you get the wrong class? I told him no, I am actually in this class, and he said to me: ah you have got the balls, are you sure you are going to pass? Because it is not an option for you girls, we know that you girls choose A [literature] or D [biology] so that you can do your make-up. Here there is no time for that. You have to concentrate. (Nadia)

This finding of discouragement is crucial as it shows the need to train and educate secondary school teachers on diversity and inclusion for children. Despite their exposure to **gender stereotypes** and remarks about their abilities from secondary school teachers, the women in our sample managed to find their way into scientific and technical fields.

Gendered stereotypes in higher education

Even at the higher education level, **gender stereotypes** persist and thus, affect the experience of female students in STEM. Indeed, most respondents told us they had some comments from friends or family relatives when they mentioned studying in the STEM domain. Consider these quotes from 5 respondents

It is an ambitious choice (Isabelle).

They[people]say to me "ah but there are lots of boys, do you find yourself? do you like it [her option]? do you find your place"? whereas a boy who says that, the first reaction they will have is: "what is your option?", "what is your project at the moment?", "what is your thesis subject?", but for me the first reaction I have every time is always "Ah you must not find it easy". (Sophie)

How are you doing [in her studies] ? And in what year are you? How are you?" as if I had difficulties compared to others. (Stephanie)

It is daring for a woman in fact. And for example when I tell people what I do, I explain it to them, they will tell me "do want to become the next Einstein or what"? for them it is a bit surprising, because it is much more a boy's field in general. and so, when you are a girl in this field they say "ah ok she's got a big head". It is often a bit frightening because people often say that when a woman studies too much, she does not settle down much, and scares away the men (Nadia)

Every time I tell people I was doing physics, they all said Ah, this is a very difficult study. That was the first reaction, like you have to be really brave to do it. (Chloe)

Moreover, girls added that they had to deal with family members who still had **preconceived ideas** about women studying STEM. Sophie mentioned how disappointed her grandmother was when she heard Sophie did not want to be a doctor but an engineer. Juliette remembers her grandparents telling her STEM studies were very difficult.

In her head, she feels like I came down the ladder since I said I did not wish to go to medical studies. For her it was that or nothing. (Sophie)

My grandparents said to me: Do you realize that it is quite a hard study? I said it did not bother me at all. (Juliette)

Still referring to stereotypes, Banchefsky et al (2016) reported that women also face **appearance-related stereotypes**. Women looking too feminine send signals that they may not be suitable for science. Consistently, two students also mentioned that people have certain clichés about girls being either beautiful or intelligent in STEM. They said that most girls do not care about their appearance. Therefore, when a girl tries to look pretty, she often gets sexist comments. Chloé said that she once made herself beautiful before going to class and a boy in her class commented about her being beautiful to seduce boys. Nadia agrees with Sophie, adding that girls in science do not take care of their appearance where she comes. She even said they look like boys.

“Ah you wear make-up; it is obvious that you do it for the guys” (Chloé)

Where I come from, when a girl is into scientific options, it is more like she does not take care of herself. They look a lot like boys because they don't have time to take care of themselves. You have to breathe Maths and Physics. (Nadia)

Gendered microaggression in higher education

Another point raised by our student respondents was that they experience microaggressions. These include inappropriate comments, offensive remarks, or mean looks from professors or other students. Leonor has returned to IT training, and she explains the misogynistic remarks she received from the trainer. Moreover, Juliette says that a professor repeatedly told her that she did not belong in STEM studies. Similarly, Sara mentioned a supervisor who made a comment about PhDs not being for women.

(...) there were sometimes small remarks by the person giving the training. It was a bit misogynous, but I never took it personally. (Leonor)

I was repeatedly belittled by professors who insisted that I had nothing to do with these studies even though I was already in the 3rd of my bachelor's degree. (Juliette)

There is the former supervisor of my supervisor, namely X, (...) He asked me: what do you want to do? so I told him that I wanted to do a PhD. He told me that PhDs are not for girls, in an ironic tone. (Sara)

The absence of gender diversity in higher education

We noticed, during our interviews, the existence of a considerable gap between female and male students in STEM in Belgium. All the respondents confirmed that boys outnumber girls in their different classes. However, they expressed a mixed opinion regarding the impact of the lack of **gender diversity** among students in STEM classes. We asked our respondents how they felt studying in a male environment. These examples clearly illustrate the contrasting views of the students on this point:

It is ok, it does not bother me so much. Because I have a girl with whom I often sit and work together. Moreover, it does not bother me because when I was in physics in Cameroon, there were not many girls either. I was used to not having many girls in my class. (Kaina)

Yes, for the first few weeks it was very frustrating to see just a few girls in my class. But then I got used to it and the boys who were there were nice, and we studied together sometimes. (Magnolia)

So, this year it really bothers me, whereas before it never really bothered me. I just feel a bit lonely in the class. (Chloé)

Lack of role models in STEM education

The absence of **role models** in education also influences girls' experiences in STEM studies. Indeed, Blickenstaff (2005) points out that the lack of women in science leads young girls to believe that this field is not attractive to women. This also signals women's inability to succeed in the STEM field (Herrmann et al., 2016). Thus, preventing female students from choosing a STEM major or thinking of a career in STEM fields (Blickenstaff, 2005). Generally, our respondents declare not knowing or having any female role model. Surprisingly three ethnic minority students mentioned having minority role models but added that they were not working in STEM fields.

Nevertheless, they claimed to have been influenced by the background and experience of these women. Nadia spoke of her mother being her role model in family life, Michelle Obama because of her personality, and Marie Curie because of her discovery in physics. Kaina and Kayla mentioned their aunt, who were businesswomen, one worked in a bank, and the other had a company.

Yes, I have several role models, women who influence me. For example, Michelle Obama. I really appreciate her tenacity, the difference she makes and the strength she gives to women. Marie-curie too, because she innovated chemistry, science in fact.

she is my role model on the study side. Michelle Obama is my role model in terms of personality, Marie Curie in terms of studies, and in terms of family life, it is my mother. So those are my three role models. (Nadia)

I had people who inspired me or encouraged me in what I am doing now, but they were not necessarily in the field of science, it was an aunt (...). This aunt was a banker. There was also another woman who inspired me a lot, she works in a company in Cameroon. But they were not in science, they were not really engineers. (Kaina)

I had my father's aunt, who was not really into engineering or anything like that. She started with teaching, then became a director, then she started to run her business. (...) She was influential. Everyone listened to her when she spoke. And that really inspired me. (Kayla)

Regarding role models, we noticed that there are few female professors in technical and scientific fields in Belgian universities. The **lack of gender diversity** among professors in STEM is very striking. Most of our respondents said they have one or two female professors. Others claimed they had never had a female professor.

I wonder if we even had a female teacher. I do not think so. (Jeanne)

In bioengineering there are only male teachers. (...) I only had three female teachers in my whole program, in a lot of courses. (Sara)

I had very few female teachers, I remember a few female assistants, but I do not even know if I had female teachers. (Susane)

It is interesting to note that both white females and ethnic minority students express a mixed view regarding the influence of a role model on their experience. Some believed a role model could inspire them and make them feel confident about their skills. This seems to be the case for Magnolia, who said she had a tutor who inspired her in her studies and gave her advice on her future career. The same is true for Isabelle and Chloé:

During my studies at EPHEC, I had a female academic mentor who was my tutor, she encouraged me not to give up and to find a job in the field. (Magnolia)

If it is a woman, I will be inspired as there are not many of them... I will be deeply inspired by the fact that these women remain in the field of science even though there are not many girls. (Isabelle)

There is a new teacher at UCLouvain in physics, and we have almost no female teachers. And she is a new teacher, and I find her quite inspiring. So, I spoke to her a bit before because I was lost this year, and she gave me confidence. (Chloé)

Others said the lack of female role models did not affect them. Elena thinks it is a pity that there are only men as teachers, but she never felt like it influenced her. The same is true for Sara:

So far, I think it is sad. But I have never felt that it influenced me or anything. I just think it is a pity that there are only men as teachers. (Elena)

There is Marie Curie, but I confess I have never been [influenced by a role model]. I am not the best at remembering the names of scientists. It was never my motivation to say I wanted to be like that scientist. No, not more than that. No, I had no personality in mind. I never thought I wanted to be the new Marie. (Sara)

We tried to put in common all the difficulties faced by both white and ethnic minority female students during their studies. Nevertheless, we noticed that for some barriers, such as the lack of role models and the absence of diversity in STEM, the ideas and opinions of some respondents were utterly different from those of others, which we felt was essential to highlight. Some claimed they did not mind the lack of diversity in STEM since they had always been in a male environment during their studies and got on well with boys. At the same time, others felt affected by the lack of diversity to the extent that they developed imposter syndrome. This phenomenon will be discussed in the individual barriers girls face in STEM studies.

Lack of self-efficacy

It is noticeable that both white female students and ethnic minority female students reported a **lack of self-efficacy** as a barrier to their student experience. Several studies found that self-efficacy is an essential mediator of gender differences in the attraction to STEM careers (Rittmayer et al., 2008; Tellhed et al., 2017). Indeed, female students' low perception of self-efficacy regarding their maths and science skills is why they often tend to leave the STEM field. Indeed, during the interviews, most of the women initially had doubts about their ability to succeed, although they admitted to doing much better in the end. These excerpts from Elena and Chloé are good examples of the lack of self-efficacy experienced by female students:

I consider myself a bit of a loser, so it is not the people who made me feel that way. It is me underestimating my skills. (Elena)

I know I did not feel too confident in class compared to all those boys. They are really smart, and I always felt a bit worse than them, even though I often got better marks than them and I felt a bit small in the class, compared to all those boys. (Chloé)

Feeling a gender-related need to prove oneself harder

In addition, female students constantly believe they have to **prove themselves** because of their gender. Anne says that when a girl passes the engineering entrance exam, she believes she has the right to prove that she can be an engineer, unlike boys who already know in their minds that they will be engineers. Indeed, girls put a lot of pressure on themselves to prove to their family and friends that they can succeed in STEM studies. This constant struggle to prove oneself sometimes leads to health problems, including stress and depression. Melanie had a burnout last year because she puts much pressure on herself.

Many of us in engineering think that when a guy passes the entrance exam in his head, he will be an engineer. When a girl takes the entrance exam, she has the right to prove that she can be an engineer. (Anne)

I admit that I find it hard to know [why she puts a lot of pressure on herself]. I think it has a lot to do with my personality. The fact that I am a very perfectionist. So, I put a lot of pressure on myself too. (...) the rhythm can be pretty intense. Well, you think about courses, you do courses and sometimes, come on, I remember, sometimes I even dreamt of courses. But, at that level, it is also my choice to work a lot. (...)I did have a burn out last year. But I do not think it is just... I do not know for sure, but I think it is something that all students in all majors could experience, and it is just the pressure. (Melanie)

Impostor syndrome

Most of the female respondents identified **impostor syndrome** as another obstacle they encountered during their studies. Impostor syndrome is a feeling that causes someone to doubt his or her abilities and performance to the extent of fearing being exposed as a fraud (Hawley, 2019). According to Navarre (2020), this phenomenon is widespread among social minority groups that are discriminated against. It is commonly experienced by female students, researchers, and academics. However, recent studies proved that men could also experience impostor syndrome (Chakraverty, 2019). Accordingly, almost all our respondents, male and female, said they had experienced impostor syndrome during their studies. Chloé spoke about how she felt less intelligent, while Sophie talked about her gender, making her feel she was not in the right place.

I succeeded in almost everything. But I still feel like a failure. I feel like I got lucky with COVID. (Chloé)

I asked myself: “what am I doing here?”, and I really have this little impostor syndrome that feeds on all alone and the fact that I am a woman adds a little salt to it. (Sophie)

However, it is interesting to highlight that ethnic minority female students reported having this impostor syndrome not because of their origin or color but rather because of their gender. We asked Helena, a student in IT who has Thai origins if she had experienced the impostor syndrome during her studies:

A lot [impostor syndrome], but it is often when I struggle with projects. And I ask myself, how can I get to a master's degree and struggle with this kind of thing? So, I said to myself, I do not deserve to be here at all. I do not know if it is because I am a woman. (Elena)

Pierre is an ethnic minority male student who also claimed to have impostor syndrome because of his skin color. He said he suffers a lot from impostor syndrome associated with the fact that he is black.

I have a lot of imposter syndrome coupled with the fact that I am black. I always think: Do I belong here? How come there are so few people like me here. (Pierre)

In general, we observe that female students have to go through personal barriers because they still believe they are disadvantaged because of their gender. We want to emphasize that this desire to prove themselves to others is because they suffer from impostor syndrome. Similarly, ethnic minorities encounter impostor syndrome because of their gender and ethnic origin for some, others because of their skin color.

4.1.2 Obstacles mentioned by ethnic minority STEM students

First, we present several contextual barriers related to ethnicity regarding STEM education at the contextual level of the university environment or society. Secondly, we mention the individual-level barriers that ethnic minority students face in STEM education.

4.1.2.1. Contextual Barriers

Struggling to get accepted for school assignment groups

In Johnson's (2011) research, we previously saw that ethnic minority students struggle to be included and entirely accepted in the classroom. They are avoided by the white student when selecting partners for group work and assignments. Accordingly, the ethnic minority interviewees reported having trouble making friends, especially non-natives or international students. Kayla says that it took her three years to feel integrated and have friends. At that time, she had to do all the projects alone because there were no other ethnic minority students in her class. Though Stephanie thinks the others were avoiding her because of her appearance.

However, we noted that those who did not mention having difficulties finding a group said they had one or two ethnic minority friends with whom they did all their group work.

It was difficult to build the groups to do the projects (...). So, I did all the projects alone because there were no other Africans or Arabs in my class or other foreigners. So that was the real difficulty. It caused me many problems, doing the projects by myself, and not finding groups. (Kayla)

"I do not think anyone will ever come to me and ask me to be in their group, and I think that it is mostly because of the way I dress or the way I do my hair. But then it is personal, I do not know if it is really that. (Stephanie)

There were 100 of us! We were asked to put ourselves in groups to do a project, I sent messages and I never received any reply and at the beginning, I often found myself in groups where there was me, the black guy, the guy from the Philippines, and the Portuguese woman. (Didier)

For friendship, I would say, I always work with a Cameroonian girl who is in my class, for example. When there is a group assignment in which we have to choose, I always work with her. (Nadia)

Lack of networks to find internships

Likewise, two respondents spoke about not having enough connections or **networks** when looking for their internships. However, Kayla succeeded in doing her internship thanks to a friend of her uncle. Nadia said she sent her résumé to four companies and got only one answer, yet the deadlines were over. For Magnolia, it was challenging to find an internship because of the Covid crisis.

I managed to do it [to find an internship]. But it was not my dream internship. And I put myself in the shoes of other foreigners, frankly, it is difficult. (Kayla)

It is difficult because we do not have enough information and we do not always know at which door to knock on. (Claudia)

The absence of ethnic diversity in higher education

Ethnic minorities also shared their views about the absence of **ethnic diversity** on campus when we asked how their class was composed in terms of minorities. Regarding their answers there are few ethnic minority students in STEM in Belgian universities. However, two respondents (Isabelle and Stephanie), compared UCLouvain and Université Libre de Bruxelles (ULB) They claimed ULB was more racially diverse than UCLouvain, which is comprehensive because ULB is located in a multicultural city with people from many different backgrounds. Yet, it seems necessary to highlight how important it is for some to study in a diverse

environment. Isabelle said the lack of ethnic diversity was one of the reasons why she had to change from UCLouvain to ULB.

At the UCLouvain, there was not much diversity at that level, but at the ULB there is much more. I am glad I changed for this reason, and I find more diversity in terms of ethnicity at ULB. I grew up in Belgium, I am Belgian, but I still feel that there are few people who are like me. (Isabelle)

And it is true that I have already had a bit of trouble not identifying myself in a classroom, but at the ULB, I do not know what it is like, but on the campus alone, there is really everything. Whereas here, well... (Stephanie)

Four out of ten ethnic minority students mentioned they would have enjoyed having more representation at the university. They underlined that having more ethnic minority female professors would have allowed them not only to have people to identify with, but it could have been a source of motivation.

I think it has an impact because you also see that it is possible for someone "like me" to find themselves in that kind of position. You identify with it. So yeah, I think it is important to have a mix. (Jeanne)

I would have thought that it is possible, for example, to be accepted, because already standing in front of a class, is not something that is given to everyone. And on top of that you are black and a foreigner, so that means you have really earned your place. And that had to be a motivator. (Claudia)

The auditorium, I do not really care about that. But I would have loved to see ethnic minority women as teachers. Even to identify a little bit, even all the questions I have about work, about quotas, that is stuff I would have wanted to ask but it would make less sense for me to ask the teachers [Male professors] that I have now. (Stephanie)

Magnolia, Kaina, Nadia, and Melanie mostly had white male professors. However, they claimed it did not influence their experiences. Nadia even added that if there were no female professors, it was maybe because the university did not find one really qualified to do the job. For Melanie, it does not matter because she said she was never close to professors.

Racial (and racially gendered) aggressions

Ethnic minorities are subjected to **inappropriate** comments and remarks partly because of their skin color for men. For women, these aggressions are not only related to their gender but also because of their skin color. The respondents frequently mentioned that it was sometimes silly comments, which to some would be taken lightly, and yet to others, it feeds their imposter's syndrome.

But I remember once a teacher who made twice, three times a comment and it pissed me off, it annoyed me. Once, I remember, he [the teacher] showed us something, he was explaining and then he used the pointing device on the board. And there was the Moroccan who passed the slide to answer a question and the command did not work. He said to him: “ah but Ayoub, you do not have that in Africa or what?” (Kayla)

Not only did I not know anyone because I was not in the same program as them, but there were also these questions: “Who is this black man coming?” (Didier)

Other subtle forms of racial discrimination

Moreover, we thought it was relevant for our research to discuss the issue of **discrimination** faced by ethnic minority students in STEM. Indeed, we noted various responses when we asked them if they had experienced any forms of discrimination during their studies. According to Adrien's comments, the discriminations are rather subtle. Nadia even added that they would not show it to your face, but you feel it in some people's looks or the behavior, and Stephanie thinks she has been discriminated against because of her appearance.

I think it [Discriminations] is often done in a rather subtle way so I do not have an example that comes to mind. (Adrien)

It is true that here we do not show this side much, but you can feel it, when you ask the questions, it shows in the way people look at you, like you are a woman. And also being black has an impact, a woman who is black and who works in science has an impact. But they are not going to say it like that because it is going to be a little blatant but that look, all that has an impact on your grades. (Nadia)

Other respondents (4) clearly stated they have never been discriminated against based on their gender or origin, considering the extracts below:

I did not feel like I was discriminated against because I was a girl or because I was Asian. (Elena)

I did not have that kind of problem, fortunately. (Jeanne)

During my studies, I never felt any difference because I was black. There was a lot of solidarity among us, we were like a family. (Magnolia)

Maximum allowance of foreign students

Lastly, we had three students who mentioned the issue of **quotas** for ethnic minority students in some universities and schools in Belgium. It appears a limited number of foreign students can enroll in Belgian schools. Magnolia thinks the same is true for all other institutions in Belgium. Interestingly, having this quota system in some schools seems a big challenge for

ethnic minority students, especially those in STEM fields. Consider these statements by Magnolia, Kaina and Aylin.

There is always a quota for foreigners in any institution in Belgium, I think. (Magnolia)

Already for foreigners, if there was no quota it would be good. (Kaina)

Sometimes there were rumors that the Haute École imposed quotas for foreign students. (Aylin)

After looking at all the obstacles face by student in STEM during their studies, we realized that even though some obstacles are common regardless of gender, Ethnic minority female students also have to deal with racism. The intersectional aspect is well illustrated in the case of black female students. These results support the idea that ethnic minority female students in STEM experience the “double bind” because of their gender and origin. It is also striking how different ethnic minorities perceive these challenges. Some seem to be very concerned and affected by these difficulties, others prefer to ignore them, and few believe they are not affected at all by all those difficulties.

Feeling an ethnicity-related need to prove oneself harder

We saw in the literature review that ethnic minority female students simultaneously face sexism and racism. This phenomenon, named the "**double bind**," appears to be detrimental to the performance and the experiences of ethnic minorities in STEM studies (Ong et al., 2011). During our interviews, we realized that almost all the ethnic minority students we interviewed mentioned having **to work twice as hard** as others. When we asked the ethnic minority students why they believed they had to do so, both girls and boys came up with different reasons. On the one Kayla added that for non-migrants, it is like everything is for sure, but foreigners have to do a lot to deserve their place. yet, Nadia, Melanie, and Adrien believed they had to work hard because of their origin.

Yes, clearly. Unfortunately, I have the impression that for the others [ethnic majorities], it is as if their place is already guaranteed while you[she as an ethnic minority] have to prove things. (Kayla)

But I have the impression that more is asked of us, the international students. If a Belgian student makes 100% effort, we have to make 1000, and sometimes it is not enough. Sometimes you work very hard but the result, in the end, is disappointing. (Nadia)

I would say that as a minority, I cannot limit myself to the same rules. You just cannot limit yourself to just being good. For me, in terms of competitiveness, it is not very easy. (Adrien)

since I was little, well, as a minority, sometimes things happen that are a bit racist. And my mother used to tell my little brother and me that if you want them to stop looking down on you, you have to show them what you can do and that you are even better than them. It is often in the sciences where there is more respect. (Melanie)

I just feel that we as girls in engineering have to be the best all the time so that nobody tells us anything. There would have been a lot less of that if we were boys. (Stephanie)

I did not have any difficulties in that sense. I never felt like I had to make more effort. (Elena)

We noticed that students whose parents immigrated to Belgium but still have strong cultural ties sometimes tend to push their children to outperform in their studies because they think only studies can give their children a better future.

Affordability

We also listed **affordability** among the obstacles because Kaina said her studies were costly. She studies at ECAM and hardly finds time to do her student jobs. She said she had financial difficulties because she was the one paying her school fees. These are her words:

The other difficulties are more about the tuition fees which are a bit expensive. Your parents cannot pay that from the country [Cameroon]. So it is really a financial problem because I do not have much time to do a student job. If you do not have parents who pay for your studies, it is a bit complicated. (Kaina)

4.1.2 Actions for promoting gender and ethnic diversity in STEM education

Previous research described actions taken by the US government and universities to promote gender and ethnic diversity in STEM: coaching, mentorships, workshop activities to educate faculty on gender bias and the promotion of role models (Casad et al., 2021).

We also saw that the European parliament had implemented some actions to ensure gender diversity in STEM education. Said actions included creating new channels to communicate with girls, setting EU funds to finance female-led projects in the digital sector, and investing in teachers to drive cultural changes (Susana, 2019). To have a concrete and clear view of what is done by Belgian universities, we asked our respondents what actions are done to address gender and ethnic diversity.

Universities in Belgium organize **information sessions** to inform secondary school students about the different fields of study. Indeed, Elena said she attended an information session to attract young girls to IT.

(...)the information sessions, or when there's a girl that comes in, I think they still try to convince her especially. (Elena)

The students also mentioned that the **groups were automatically formed** with two to three girls to promote diversity in the group assignments; this made it easier for the girls to find groups. Kaina added that they are assigned a partner in the first year with whom they have to carry out all the group work in her school. Isabelle and Elena said that for group projects and assignments, the assistants usually create mixed groups with at least two girls.

For example, I know that you have a partner when you arrive. The Ecam has set up a pairing system, when you arrive in the first year you are assigned a partner with whom you do the work. (Kaina)

In our year project groups, they always try to put two girls in each group. (Isabelle)

They would try for group assignments to have groups with at least two girls in the group. (Elena)

Networking initiatives and conferences are also part of the actions used to promote gender diversity in STEM. Indeed, Magnolia said her school organizes "**job days**" where they can meet and discuss with professionals. Two respondents mentioned "Midi des filles", an initiative by UCLouvain. This initiative aimed to allow female students to meet and discuss the difficulties they encountered; those doing a master's degree will offer their support to those with a bachelor's degree. Sophie spoke of conferences about women in STEM organized by a "Kot à projet" (KAP).

(...) our director [female] was communicating with us a lot. They realized the lack of women and really wanted to attract them to the electromechanical field. (Magnolia)

(...)what they had done in another faculty was a girls-only lunchtime so we could get to know all the girls. In the end, I did not even attend, because I had forgotten. (Mélanie)

I feel like it is happening a lot more now, like KAPs organizing conferences about women in the sciences. (Sophie)

In some schools, students can ask for **tutors**, especially those having difficulties in some courses. However, Magnolia said tutoring is not only meant for female students. It is a service made available to help students pass their exams.

The first few years, we could apply for tutors to ask for help with a subject. You apply and they give you a tutor. (Magnolia)

While Chloe highlights the lack of **special attention** given to women and would like to see more special support from professors and the university, Melanie contrasts this by stating that she found it odd that a professor pushed her to take the lead in her group work on the fact that she was a girl and there were not many girls.

I know there was a time when I thought it was really good [to be treated equally with the boys], because at least they do not make a difference like you [girls] are worse, I can see that we are kind of on the same level from the teachers' point of view, but they [teachers] do not care. They do not see the problem, I think. And so maybe that is an issue. Maybe it is good that we are equal, but perhaps they should do a bit more to support us. (Chloé)

There was just one time where you feel that some teachers have preferences for girls. A little bit to put them forward, or else, but I do not know if it is good or bad? I do not know if it is good or bad (...) it was just that once, we needed a group leader, and he said, " since you are a girl, go for it " (...) there was another girl and I think we just looked at each other like " ah uh, weird ". (Melanie)

We want to add that, because of the Covid situation, universities had to stop or cancel some activities. Nadia claimed it was difficult to set concrete actions to empower female STEM students during the Covid pandemic. However, they often received **emails from the faculty**.

They send messages to students. I also came in a Covid period, the actions are not really noticeable. But you get messages and everything. So, I think they are making an effort with that [actions to retain female students in STEM]. (Nadia)

Finally, it is noticeable that concrete actions are already implemented to attract and retain female students in STEM. Nevertheless, most of the actions mentioned above aim to solve the problem of sexism in STEM. Nonetheless, we would like to stress that we have not identified any concrete actions, or at least the students have not reported any actions taken by the universities to fight against racism in STEM. Although ethnic minority students did not explicitly mention being victims of racism, we still believe it is essential to prevent racism and sexism in Belgian universities by putting in place actions and measures. Indeed, it will help attract more ethnic minority students to STEM

4.2. Findings related to STEM professions

In order to analyze the trajectory of women in STEM, we follow the timeline by focusing in this section on the experience of female professionals, focusing first on the general experience

of women and then the specific experience of ethnic minority women. First, we will look at their experiences as professionals during their recruitment process and entry into the professional world. Next, we will identify the obstacles and barriers encountered in their work environment by comparing the perspectives of ethnic minority and ethnic majority women. Finally, we will discuss the practices implemented by the organizations in which our respondents work

4.2.1 Obstacles to gender and racial equality during the recruitment process

4.2.1.1. Obstacles faced by women during the recruitment process

For most respondents, finding a first job in STEM was not particularly challenging. Indeed, most of our respondents report some ease in finding a job after graduating with a master's degree in STEM, regardless of their type of education (University or “Haute Ecole”). Respondents are aware of the privilege of studying in a scientific field. We have termed this phenomenon “**STEM privilege**” similar to phenomena such as White privilege, which emphasizes the advantage that students with STEM degrees have over their academic peers studying other fields. As already mentioned in the previous section, STEM is perceived in society as a more complicated field.

I think it would have been very different [if I obtained a non-STEM degree] and I would have struggled because I'm not the kind of person who is going to shine with my personality and presence in the room. (Didier)

Some students mentioned how the use of a database that acts as an interface between students and companies, facilitated their recruitment process. It reinforces the idea of a meritocratic recruitment process based mainly on technical skills rather than on ethnic, gender or physical criteria.

All our white professional women respondents indicated that they did not encounter any major barriers when it came to finding a job. Anne acknowledges that she experienced a fair recruitment process based primarily on her technical skills rather than her gender, which had very little influence:

It [the recruitment process] is really purely about the project and the grades, I've never heard of it being about gender. (Anne)

However, despite the belief in a meritocratic STEM privilege, some obstacles during the recruitment phase soon became noticeable in the interviews. Some of the female professionals interviewed mentioned the role of **family status** as a barrier in the recruitment process. Such issues related to motherhood, parental leave, and how they plan to take care of children. It was pointed out in the literature that the reality that women face once they have children, would make them less competitive in the labor market (McIntosh et al., 2012). Consider the following quote:

(...) I had an interview with someone from HR and it's true that I had questions: "Is your partner flexible?", "Will he take care of the children? (...) I have the impression that he would not necessarily have asked that question to a man because there are still prejudices like that it is the woman who will stay at home to take care of the children. (Susane)

Gender also influences access to promotions and the recruitment process that this entails. Susane has been working 4/5 time since she gave birth to her last child and feels that she has less of a chance than someone who would work full time to get promoted.

So yes, for this kind of job, you have to be very available. I think it would be possible, but then I would have to start working at a good pace that is compatible with the expectations of the job and my family. So, I think that as long as I stay with part-time jobs, I am not sure that I would be offered it. (Susane)

4.2.1.2. Obstacles faced by ethnic minorities during the recruitment process

Respondents from an ethnic minority background mentioned how a **foreign-sounding surname** negatively influences the recruiter as soon as the CV is read, which discriminates against foreign students. To counter this, Didier decided to change his approach and to have direct physical/real contact with companies, while Jonathan decided to change his last name so that it sounds less foreign:

"When the first contact is not made physically, my experience is that very often it is very complicated when you have a name with a foreign connotation. (...) one of my strategies was to change very quickly the approach I had in relation to the initial contact. (...) I tried to get the contact in person, either by phone or by seeing the person directly." (Didier)

(...) because they [his parents] were tired of being associated with that last name, which did not even sound Arab-Muslim, but terrorist they said. (Jonathan)

The following respondent mentions the alleged preference for ethnic women with **straightened hair**:

But it is true that it freaks me out a little when I hear that in the professional world, I am told that you get judged a lot at first interviews, that frizzy hair is not always well seen. I hate straightening my hair, so I really want a company where I am accepted, and I can do my hair the way I want. (Stephanie)

In addition, there was the issue with being expected to speak **different languages** that could pose a problem for some ethnic minorities:

You need to have the Dutch language, which unfortunately I don't have. (Marie)

(...) I started looking in Flanders (...). It went well because the language helped me a lot. (...) Most of the Flemish people speak English, so if you already speak English it can help. But I think it's a little bit more difficult if the person doesn't have Dutch. (Jeanne)

Language, of course, because Belgium has two national languages and one of the companies told me you should know French fluently. And because our meeting will be in French and others said, no, we need Dutch, And it's a big challenge also. (Eva)

In addition, one respondent stressed the **lack of networks** due to her ethnic minority status, as causing difficulties in finding a jobs:

Because it's a big company, and I don't have a contact in that company. I think that someone who has a contact in the company will be easily taken over from me, you know... (Kaina)

Especially for respondents without **European citizenship**, finding a job in their field of expertise in Belgium posed administrative difficulties. This began already in higher education, and then persisted in the job market. Consider the following excerpt:

It is difficult for foreigners in general. (...) they would say to me: "Just to clarify, what is your origin? I mean, do you have European nationality? I said no. They would say to me: "Well, that is going to be a problem. (Kayla)

Finally, ethnic minorities and women mention a fear of **being hired solely for their minority status** as women or ethnic minorities in order to fill a quota for the company, which accentuates the imposter syndrome. Consider the following examples:

There are companies that are looking to have a certain percentage of women in their company to win in competitions, to have titles, 'Best Workplace' style. It is just for their image, but it helps. (Kayla)

(...) I know they [big companies] have quotas now and they need a certain number of girls, and they are recruiting more girls from different ethnicities that are outside the typical Belgian profile. I know they like to do that to show that they are open to the world. So I am a little afraid that in the years to come, I will be taken for a job just for that. It's fine if they take me, but I'm afraid that they won't really see my skills, but they'll take me just because I'm a girl and I'm mixed race. (Stephanie)

Given these barriers that many of the respondents faced in their early careers, it is no surprise the following student realizes her ethnicity might act as a brake on her future career development:

I think yes being a black woman. The difficulty first is that you are African, and they are not going to take a chance on giving you a job that is worth your abilities. (Nadia)

4.2.2 Obstacles to gender and racial equality beyond the hiring process

This section analyzes the experience in the professional world of women in STEM. We focus first on the experience of women in general. Next, we look more specifically at the experience of ethnic minorities. Finally, we identify whether these barriers are a hindrance to our professionals in their career development.

4.2.2.1. Obstacles beyond being hired for women in STEM occupations

The theory presented us with a hostile and cold environment in STEM jobs (Casad et al., 2021). However, most of our respondents recognize that they work in a positive environment. There is a supportive and pleasant atmosphere in which respondents do not feel the competition, which is consistent with the viewpoint of the female students who were already reporting a high level of solidarity in their university classrooms.

it's a nice atmosphere, we get along well. (Leonor)

I feel good. I don't have any problems. (Sabine)

However, the women still testify to a certain hostility encountered against them when we delved a little deeper into their experience. We elaborate on those topics in the following sub-sections.

A male-dominated working environment

Most of the female professionals we interviewed acknowledge that they operate professionally in a **male-dominated environment**, regardless of the STEM field. This aligns with the ideas

of Fatourou et al., 2019 & Solis Perez, 2019 presented in the literature review. Still, Sabine notes some evolution in recent years.

Very few women, of course. (...) I think we were three girls out of 80 men. And that battle in the workplace as well, we have a little bit more now, but it's still mostly men. (Sabine)

Leonor is the only woman in her team of 50 developers, while Anne, a researcher, has 2 girls in her lab of 8 people. Only 1 respondent stated that she works in a balanced environment with an equal distribution between men and women. However, she pointed out that this was because she works as an engineer in a public administration and that quotas were therefore imposed. Jeanne mentioned that the field of architecture still had more women than she had seen in other STEM professions, which was also shared by Sara in bioengineering. Jeanne went freelance last September and is self-employed. However, she still confirms the hypothesis by stating that when she worked as an architect on construction sites, there were almost no women.

When I worked for a boss, what I found most difficult was that on the construction site, it was often [only] men (...) I would say that there are more women architects than there are women engineers (...) 40-60 which is starting to become good but we are not yet at equality. (Jeanne)

The implications of working in a male-dominated work environment are not the same for all respondents. While Susane and Sabine say they are not bothered by a male-dominated workplace, Sara is not always comfortable working in a male-dominated profession. However, most of the women we interviewed note with regret the lack of gender diversity in their profession in Belgium, which is consistent with the literature (Cole & Espinoza, 2011).

An additional idea brought by several of our respondents (Didier, Adrien, Kayla) underlines that this underrepresentation of women in the scientific professions also depends on the **country** in which one is located.

Knowing that in Algeria the gap in technical fields between girls and boys is less visible than in European countries. (Kayla)

(...) in Iran, 70% of the people in engineering are women. So, it's not so much a question of interest, it's just a question of the social reality of the country you're in. (Didier)

Finally, Jonathan points out that most of the women in his company are in management positions rather than the more technical positions. This still shows a certain reluctance of women to go into STEM fields.

Typically, HR is all women, and the people in the team who give training are all women too, there are no men, I think. In the support team, we call it the infrastructure, it's all the people who take care of the PCs. There is a little bit of technical hardware and, there are two girls and in the team of developers, there is not a single girl on the other hand. So that has its impact anyway. (Jonathan)

Lastly, although the professional women recognize the lack of role models in the professional world, they did not feel this was an important obstacle to their career (unlike argued in Gibson, 2004). Consider the following quote:

No [no influence of the lack of role model] because it was also somehow motivating to think that I was going to try to conquer an unknown territory. (Léonor)

A family-unfriendly working environment

Respondents identified the STEM field as demanding and not allowing for a work-life balance. Thus, working in a family unfriendly environment could constitute an obstacle in the career development of professional women.

I have a friend who is in the same company, in the same department, she works in an engineering position, and she is doing a project. And so, she does not have to calculate the hours she has to go back home (Marie)

(...) we tend to work overtime quickly because there is no break. (Jeanne)

Although one of them mentions that she does not see any problem in reconciling the two. Another said that this is what led her to choose a job in public administration with fixed hours to be able to benefit from school vacations so that she could be in sync with her children's schedules.

Different sub-categories emerged from evolving in a family-unfriendly environment during our interviews: the desire to start a family, motherhood, the influence of a partner, balancing private and professional life, and the influence of parents on the evolution of the career path in the scientific fields. It is important to distinguish between young women workers who have just started their professional life and women professionals who have been working for several years in their profession.

First of all, **the desire to start a family** comes up for some women. Sara, Anne and Kayla mentioned the desire to start a family while they were still at the beginning of their professional

careers, even though one respondent said that it was not a priority. Anne pointed out the **glass ceiling theory** presented in the literature (Lockwood, 2006).

The time when you become a teacher you have to be very competitive at the publication level typically people become teachers between 28 and 35. And what happens between 28 and 35; that is the age when people are thinking about starting a family. (Anne)

Juliette brings an interesting and complementary approach by expressing the advantages of starting a family while young in this environment:

It can be positive just as it can be negative. Me, today I have four children so he might think I'm going to stop here and not have any more children. (Juliette)

As mentioned by McIntosh et al. (2012), **motherhood** has many implications for professional women. The dominant idea is the decrease in competitiveness due to maternity leave, brought about by the reduction in working hours. Juliette emphasizes the pressure to remain competitive and to put in more effort than their colleagues who do not have children. Consider the following quote:

I feel like as a young mother, you have to work harder than anyone else to show that even though you're a mom you still have to show that you can do the job. (Juliette)

Five of them mentioned the positive influence of their **partner** in the distribution of tasks and help from **parents and relatives**, recognizing how difficult it would have been if they had not had this support.

I found myself alone, a woman, a working woman with a child on my hands! (...) We call on the family, on people we know, to be able to manage the 40-hours week. (Sabine)

But it really depends on also to the husband that should understand or not. If the husband doesn't understand, the balance is really difficult. (Eva)

Finally, in general, the respondents mentioned the difficulty of **conciliating their professional life with the private sphere**, insisting in particular on the fact that they do not have to count their hours in this type of very demanding profession.

I have a friend who is in the same company, in the same department, she works in an engineering position, and she is doing a project. And so, she doesn't have to calculate the hours she has to come in. (Marie)

Because we tend to work overtime quickly because there is no break. (Jeanne)

Although one of them mentions that she does not see any problem in reconciling the two. Another said that this is what led her to choose a job in public administration with fixed hours to be able to benefit from school vacations so that she could be in sync with her children's schedules.

Gendered-based aggression

The professional women in our sample were also victims of gender-based aggression. These are comments, derogatory remarks, or aggressive behaviors experienced directly (aggressions) or in more subtle (microaggression) ways in the workplace. Regarding **sexual harassment**, some received derogatory remarks about their presence in the field, and two testified about sexual jokes they received. Sabine describes these *"jokes as being saucy and sexual in nature."* This same respondent also experienced physical touching by one of her co-workers, which constitutes a physical assault:

another colleague who (...) came and put his hand on my butt. And I said to him, "What are you doing? And he said yes, but you're having a good laugh with us" (Sabine)

Six respondents mentioned the fact of not being taken into consideration and the impression of **being invisible**, which confirms the statements of McGee & Bentley (2017). Consider this quote:

It was hard to let your voice be heard in the room. (...) So the worst thing is that sometimes they forget that I'm even in the meeting. (Kayla)

This leads to a general feeling among our female respondents that they had to make **more effort to prove** themselves in order to be considered on the same level as their male colleagues. The arguments of these 3 women illustrate this point well:

I think we have more to find that despite everything, we have to fight more to prove the same as a man. (Sabine)

I would say that it is perhaps a little more difficult with people of the older generation. (Susane)

we're not always taken seriously, and we always have to prove ourselves more than men I think. (Juliette)

A related issue was the situation where respondents reported their work **being double checked** by colleagues, equally demonstrating a lack of confidence in their skills:

We have to check it after your work. "Hugo, can you check with her?" When I know that Hugo has the same status as me. (Kayla).

He had weird practices, for example, he would ask me if I understood correctly and if I said yes, I had to re-explain what I understood which he never did with my other male developer colleagues. (Leonor).

In addition, some men are **paternalistic**, specifically towards younger women workers:

We often have meetings with other unified teachers who are always in agro, and you quickly get one who doesn't take you seriously, who will wink at you a little in good girl mode. (Sara)

There was one person in the team who was in his fifties, whereas I usually deal with young people. With this colleague it was much more complicated, I had to tell my manager that it wasn't going well at all and he himself had noticed. (Leonor)

There are several **consequences** to these aggressions/microaggressions. First of all, although some aggressions seem quite violent and direct, professional women **internalize and trivialize** these discriminating situations experienced within their organization according to their personality. Some take it as a joke and stress the importance of being humorous and accepting macho remarks.

So, you must have a certain degree of humor and accept the little jokes, the little remarks about the fact that they are a little bit macho. I would say that you shouldn't get stuck on that and that you should take it with humor and continue to show that there is no problem. But it's true that it's not always pleasant. (Susane)

Others feel that they cannot change their organization's lack of response to these behaviors and **ignore the remarks** to preserve themselves.

I have been on construction sites where the workers took great pleasure in putting all the pictures of asses right in front of the desk I was sitting on. Nothing was put in place to help me. (Juliette)

I protect myself, so for me, it goes very well. When I hear this kind of nastiness in the open space, I put on my helmet, I do my job (...) They know more or less who says what or who does what, but they are not very reactive. (Marie)

Finally, we observe that these remarks sometimes lead to a **drop in self-esteem** among our respondents. Four of them expressed the fact that they did not always feel at home in their profession and that they had many questions.

It's true that I still have a lot of questions and maybe I doubt my skills a little too much. (Susane)

Lack of support from other women

As Grogan points out in the literature (Grogan, 2019) some respondents reported **hostility from women** within their organizations. There were various reasons for this, such as age, generational difference, and competition between women to keep their place in the field.

In fact, if there is a woman who is in the scientific world, she will rather make sure that other women are not as well accepted. (Sara)

the women who think all this, are women who do not have children or women who are very old and therefore they made their life and now feel free to speak. In fact, they are often women who have taken refuge in work. They have had problems in their lives and so work is their whole life. (Marie)

I remember there was a colleague when I started who always remarked to me that they were engineers except that I am an engineer too (...) it's pretty amazing no but it's also old school. (Juliette)

Other obstacles

Professional women also face other obstacles that are not directly related to their gender but to other external factors. We can mention the **COVID 19 crisis**, the difficulties of **working in teams**, the **corporate culture** that encourages working more. In the specific context of Belgium, the problem of the **culture clash between the Flemish and the Walloons** emerged. On the one hand, **not speaking Dutch** can be an obstacle. On the other hand, working with **Flemish colleagues** highlights the marked difference in culture between the Flemish and the Walloons, even though we are dealing with the same country.

4.2.2.2. Obstacles beyond being hired for ethnic minorities in STEM occupations

Racism and intersectionality

First, some ethnic minority respondents acknowledge an **underrepresentation of ethnic minority** in their organizations, although some of them pointed out that it is not surprising given the fact that they work in Belgium.

There are a lot of Belgians. There are very few people of other origins. For example, when I go to the canteen, I can assure you that 90% of the people there are white/Belgian. (Marie)

As black women, I remember that we were also in the minority. (..). We are still in Belgium. (Jeanne)

However, we note a difference in discourse depending on the geographical area and underline a greater diversity when people work in Brussels.

(...)in relation to the percentage of racialized or non-racialized people, in the two companies I've been in, in my old company, it was close to Wallonia, so it was much whiter. On the other hand, in my new company [in Brussels], there are a lot of racialized people. (Jonathan)

And that's why when you look at our lab, our team in particular, we've got a woman, we've got me, we've got an Indian, we've got a guy from the Philippines, the post doc he just recruited a Chilean with a broken English. (Didier)

In addition, some ethnic minorities still face **racism and discriminatory behavior related to their ethnicity** in the workplace.

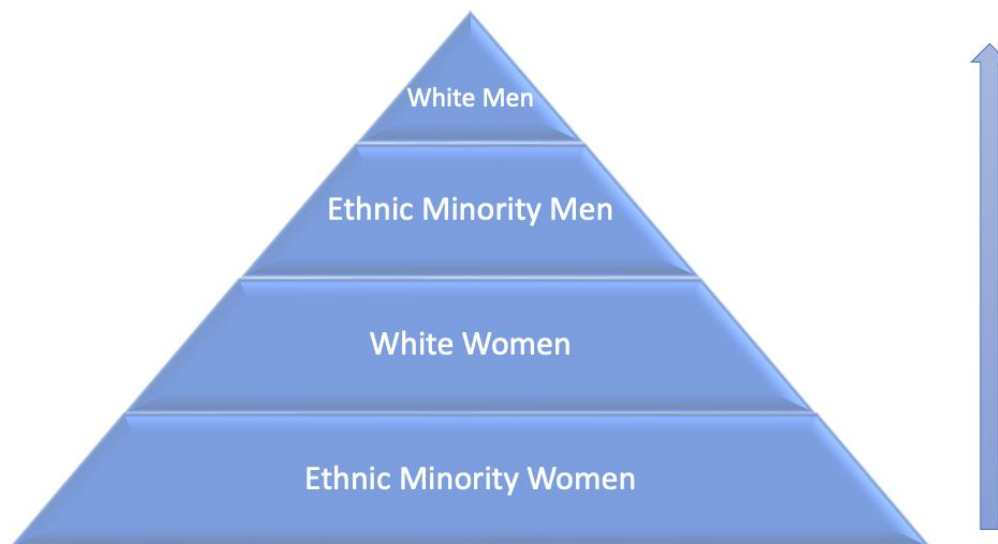
So yes, racism exists. For the moment, I have a colleague who does not know how to say hello to me because I'm not Belgian. He will never talk to me. (Marie)

Although in this analysis we considered ethnic minorities as a homogeneous group, we were still able to identify **differences in treatment related to skin color** or visible religious symbols that some communities may have.

I remember an anecdote. I had already been working there for a few months and one of the associates wanted me to understand that the fact that I was half-Congolese was not a problem for her. I was a little surprised, I didn't understand why she felt the need to tell me. (Jeanne)

Based on the testimonies, we have established a hierarchy, a "**pyramid of privilege**" based on gender and ethnicity. This hierarchy considers the experience of the profiles suffering the most discrimination (bottom of the pyramid) to those receiving the least (top of the pyramid)

Figure 5. Pyramid of STEM privileges (own figure)



Ethnic minority women would represent the bottom of the pyramid due to the **intersection of gender and ethnicity**, making their journey in STEM even more complicated than their white-skinned peers.

There was another Algerian who was a boy. We went to the same school in Algeria, we just joined the company on the same date, we have the same status, we work on the same things. So there, frankly, there is no other excuse to make the difference except between girls and boys. Because same background, same school, but you could tell they respected him more. (Kayla)

(...) in addition, my head passes because I look European. So as far as my head and my first name are concerned, it usually passes. (Marie)

You have to know that, honestly, I've never really experienced racism like that. And so I'm kind of in my own world, I don't see it. (Jonathan)

Finally, one respondent mentioned that one of the reasons she stayed in her organization was because she knew that **discrimination happened in every company** and that leaving would only move the problem elsewhere.

(...) I think that would be moving the problem anyway. I know that there are people like that everywhere and so I know that I will find this kind of situation wherever I go. So I don't see the point of changing because it's up to them to change and not me. (Marie)

Language barriers

Although this is a barrier encountered in general, the 5 ethnic minority professional women we interviewed all mentioned the **language barrier as an additional difficulty**. Two of them do

not have Belgian nationality and came to Belgium to work and testify to the barrier this poses to their professional careers:

They started the meeting in English and after a while they said we switch to Dutch, they started speaking Dutch. While I'm in the meeting. (Kayla)

Language, Of course, because Belgium has two national languages and one of the companies told me you should know French fluently. And because our meeting will be in French and others said, no, we need Dutch, And it's a big challenge also. (Eva)

The lack of racialized role model

We noticed a difference with the racialized professionals in terms of **the influence of role models on their career development**. Four of them, both men and women, expressed a desire to see more **racialized people in the top management of companies**. Jeanne and Adrien both had racialized supervisors and Adrien saw him as a mentor. He mentions a certain glass ceiling encountered by racialized people when it comes to accessing CEO positions or at least top positions in the organization.

But when it comes to having a black person as the headliner of the company, that's still a cultural change to work on. (Adrien)

"I would like to have more gender diversity in top management and have other heads. I say to myself, 'Why is it always the others who are below me?' (Marie)

4.2.2.3. A driver rather than an obstacle

We did not directly interview any women who have left STEM, so it is difficult to conclude whether professional women are really leaving STEM.

All these experiences are challenges for professional women as McGee & Bentley (2017) as well as the research of Casad et al. (2021) already pointed out. This could lead women to be dissatisfied with their jobs and make them leave STEM occupations. However, we find that for most of them, these barriers are a real driver and push them to persist in STEM and this is regardless of ethnicity. We identified similar remarks between ethnic majority and ethnic minority respondents, with this desire to go above and beyond to prove their worth and a certain pride once they experience professional success.

Yeah [talking about being proud], clearly, you come in as a girl, you go in on the premise that you're going to kick ass. (Sara)

Yeah, still [talking about being proud]. Eventually, what I went through, wanted, or unwanted, brought me to this point and for now, I'm happy with what I'm doing. (Juliette)

In general, we did not encounter any female respondents who would leave their profession influenced by barriers they encountered related to their gender, ethnicity, or both, which contrasts with the ideas emphasizing that women leave STEM for these reasons (Grogan, 2018; Liu et al., 2019).

Those who think about leaving indicate a desire to change careers **out of interest** in other occupations that have nothing to do with STEM.

Right now, I'm also busy with another project. I teach yoga classes (...) In 5 years, I would still like to have my office but also to have evolved in this part of yoga. (Jeanne)

Some also indicated that they **did not find themselves in engineering-related jobs**.

They [her friends that left STEM-related jobs] really wanted something else and they didn't fit in with engineering. And I think they also had that desire to start a business. (Susane)

4.2.3. Actions for promoting gender and ethnic diversity in STEM occupations

Based on the responses from our respondents, we were able to categorize the best practices that companies have in place to promote diversity and inclusion within their organizations. Figures 6 summarizes these practices.

Figure 6. Summary of best practices implemented by organizations (figure based on our respondent's answers)



4.2.3.1. Best practices

Positive discrimination

Among all our respondents, we find a general mixed opinion about **positive discrimination**, both for ethnic minorities and for white women. In terms of arguments in favor of affirmative action, the main argument was the importance of finding diverse teams, especially in the STEM field, which is a field at the heart of evolution and innovation. This argument echoes Chen's (2015) pointing out the detrimental effects of lack of diversity in STEM as well as negative effects on scientific advancements. Three of them (Sophie, Sabine and Susane) emphasize the complementarity between men and women.

She [the woman] has qualities that the man does not have, and we are complementary. (Sabine)

I think that for everyone, girl/boy, in general it's good to have diversity. It's ways of doing things that can be different and complementary. (Susane)

(...) in a group spirit I have the impression that we have different ways of functioning and that having both women and men is complementary and rich. (Sophie)

Didier reports a concrete example of the usefulness of also having ethnic diversity in technological fields and the societal impact this can have.

Some people had developed a system dedicated to enhancing airport security. (...) the system was trained to detect people carrying bags. And in fact, they realized that the systems systematically detected black people. (...) they realized in fact that the algorithm had just learned to detect the presence of black stripes and that therefore as soon as it saw a black person with arms, (...) it was associated with someone potentially dangerous. (...) in the team, nobody thought about the fact that there were not only white people. (Didier)

Some companies are carrying out affirmative action at different levels: imposing quotas, organizing events exclusively for women, training exclusively for women, increasing the visibility of women in STEM by displaying their photos on websites/promotional posters, etc. This is consistent with the policy adopted by the European Union to promote women professionals in STEM (Solis Pérez, 2019). Still, some respondents noted how little impact a role model would have had on their STEM careers. This contradicts what the research suggested.

Leonor returned to STEM training later in her professional career and refused to take a women-only course, Elena agrees with her position that these kinds of events are not the answer. This argument echoes the sayings of Dover et al. (2016) that recognize the danger of adopting a target recruitment process. While Sophie thinks it is useful to have **women-only events** to make women feel more confident and at home in the STEM field.

Other respondents were more hesitant about diversity and inclusion practices, which rather than coming out of altruism, resulted from a desire to **boost company image** and fill quotas. Consider the following quotes:

There are companies that are looking to have a certain percentage of women in their company to win in competitions, to have titles, 'Best Workplace' style. It's just for their image, but it helps. (Kayla)

I know they [big companies] have quotas now and they need a certain number of girls, and they're recruiting more girls from different ethnicities that are outside the typical Belgian profile. I know they like to do that to show that they are open to the world. So, I'm a little afraid that in the years to come, I'll be taken for a job just for that. It's fine if they take me, but I'm afraid that they won't really see my skills, but they'll take me just because I'm a girl and I'm mixed race. (Stephanie)

Respondents feared positive discrimination would boost the **imposter syndrome**. Many believed women should not be given a "golden ticket" to employment just because they are women. However, many of them recognize the lack of women in the field and acknowledge the fact that affirmative action can help break down prejudices and attract more women into the field.

I've had several times where I felt really uncomfortable because I'm a girl, a woman. And every time, I said to myself, maybe this is not my place, maybe I should leave.
(Kayla)

The argument that came out most often was that affirmative action was a starting point and that it allowed us to break the discriminatory system in which we live in a frontal and direct way. Positive discrimination enables to give something to minorities who would have the skills and abilities for a position but who would automatically be disqualified because of their ethnicity. However, two of them (Didier and Pierre) insisted that quotas and other positive actions were **only a starting point** and that in the long term they should naturally disappear, in the same way that discrimination would disappear.

So, I think that quotas are a consequence of the society that is made as it is, which is very patriarchal, and which is very white. We have to break these wheels somehow and quotas are a very frontal way of breaking them. (Pierre)

Day Care

To help employees, some companies organize care for children during their parents' work time. Juliette's company has implemented a daycare system and organizes **daycare for children** during school breaks.

There was daycare that were provided by the job. So, we could come to work with the children, (...) and we could work.

Training

Several respondents mentioned the importance of continuing to learn through **training** about issues such as gender and racial bias, discrimination, and workplace wellness. This practice coincides with what is suggested in the literature review, which proposes the implementation of anti-bias training in order to be aware of the conscious and unconscious biases and of the implications that this can have in the work relationships (Carter et al., 2020; Lubin, 2014).

when you start, they give you tutor training in parallel with your first practical lessons
(Anne)

However, one respondent pointed out that these types of training only attract a female audience and therefore would not have the expected effects.

I realized that in this kind of training, only women go (Sara)

Adapted material and infrastructure

University laboratories are increasingly starting to think about gender and ethnic sensitive **equipment and infrastructure**. According to the respondent, this topic must not only being discussed within universities but at the sectoral level.

This laboratory was built at the beginning of the 2000's, at the end of the 1990's and therefore everything is calculated based on the curves that were used at that time for the material. (...) These are reflections that for me, must be carried out not at the purely UCL level because for me it is questions that are specific to certain types of laboratories that in the end in certain types of faculties (...) But at the level of the sectors, I know that it is discussed. (Anne)

Gender budgeting

Public administrations are already practicing **gender budgeting**, i.e., allocating a specific budget to implement inclusive policies for women and reduce gender inequalities.

In the public domain, we do the gender budgeting. We have basic allocations and so we look at how much money goes to which policy/project. (Juliette)

Working groups

Working groups are also set up in organizations to discuss these issues and implement policies.

I know that there are working groups that exist on the subject [about the lack of women in top management position]. I know that they are aware of this glass ceiling problem (Léonor)

Flexibility

Organizations seem to be undergoing major changes in the organization and flexibility of work to promote a **better balance between private and professional life**. We are witnessing the possibility of part-time contracts, extended paternity leave, telecommuting, flexible hours, etc.

“(...) it is true that it is the fact that there are possibilities like this that allows me to continue working in the field and at the same time to have a fulfilling family life and a life outside of family life.” (Juliette)

Sponsorship and Mentoring

Finally, some companies have implemented a sponsorship system for new employees joining the organization.

when I arrived, there was a sponsorship system (...) Afterwards, concretely he did not do many things, but it was nice to have this privileged relationship with someone (Susane)

We can see in this practice a genuine desire to set up a mentoring structure within organizations with the aim of attracting and retaining professional women in a scientific career (Ma et al., 2020)

4.3 Summary of the empirical findings

Table 6. Summary of the difficulties encountered by women and ethnic minority in STEM education and occupation (own table)

	Female students	Ethnic minority students
Contextual	Discouragement from teachers/professors, gender stereotypes in higher education/ preconceived ideas, aggression or microaggression in higher education, absence of gender diversity in higher education, lack of role model in STEM education.	Struggling to get accepted for school assignments groups, lack of networks to find internships, the absence of ethnic diversity in higher education, racial and racially gendered microaggression, other subtle form of racial discriminations, maximum allowance of foreign students.
Individual	Lack of self-efficacy, feeling a gender-related need to prove oneself harder, the impostor syndrome.	Feeling and ethnicity-related need to prove oneself harder, affordability.

	Women in STEM occupations	Ethnic minorities in STEM occupations
Contextual	Male dominated working environment, family unfriendly work environment, gendered microaggression, sexual harassment, lack of support from other women.	Racism and intersectionality, language barrier, underrepresentation of ethnic minorities; ethnicity-based aggression/discrimination (racism); lack of racialized role model in top management; skin color.

In order to examine the trajectory of women in STEM, including ethnic minorities, we reviewed our interviews according to our research questions: (1) *what roles do sexism and racism play in determining women's career trajectories in STEM?* (2) *"Do women's experiences differ according to their ethnic background"?* and (3) *What are the good practices for addressing sexism and racism in STEM?* Before diving into the explanations, it is worth noting that we did not interview women or students who left the STEM field to understand their reasons for doing so. However, these findings should be used as a starting point to understand better the experiences of women and ethnic minorities in STEM in Belgium. We divided our findings into two parts: STEM education and STEM profession.

Our interviews have shown that women in STEM fields face several obstacles from education to the professional world. Already in secondary school, they deal with teachers and friends who have preconceived ideas about women in STEM. Even in higher education, women face contextual obstacles related to the environment or society. These gender-based barriers have an impact on the experience of female students. Some will put a lot of pressure on themselves to succeed in so-called male fields, and others will develop imposter syndrome because they feel they do not belong to these fields.

As far as ethnic minority students are concerned, both men and women experience racial discrimination, racist microaggressions, and racial stereotypes. In addition, they have an ethnicity-related need to prove themselves and to deconstruct preconceptions that people have about ethnic minorities. However, black ethnic minority women are more vulnerable to these barriers because of their gender and ethnic background. They are more likely to leave STEM because of the intersectionality of the barriers they face.

Furthermore, how minorities experience and perceive these barriers varies according to certain factors. As the interviews show, ethnic minorities born in Belgium feel less discriminated against and describe this discrimination as very subtle. Unlike immigrant students, they have the privilege of not having to adapt to the local culture and do not encounter as many administrative difficulties. Light-skinned minority women are also less discriminated against.

However, females and ethnic minority students expressed divergent views about the lack of gender and cultural diversity in STEM. Some expressed the importance of having more diversity in STEM as it made them feel less lonely, while others claimed that they were used to it and did not feel impacted by the lack of gender or ethnic diversity.

Moving into the professional world seems relatively easy for students. Finding a job is easy because there is an acute need for workers in STEM, and they promote a meritocracy in recruitment. Nevertheless, women still struggle with discrimination due to their family status. Minorities experience barriers related to language, background, or lack of networks and fear being hired just because of their skin color.

In general, professional women face the same obstacles as female students because they work in a male-dominated environment. However, the lack of collaboration between women seems to be an additional barrier specific to the professional environment. Additionally, having a family life in some companies is perceived as an obstacle to women's performance.

Ethnic minority professionals also face similar barriers to those described by minority students. Nonetheless, the lack of role modeling and ethnic diversity is even more pronounced. Besides, acts of discrimination or racism seem to be more direct than subtle in the professional world.

As we have seen with the students, women and ethnic minorities perceive and experience discrimination differently depending on their personality, even at the professional level. Some of them see working in a male environment as a challenge. Others normalize and ignore it. Based on our findings, we can argue that sexism and racism impact women's experience in STEM in Belgium. However, neither students nor professionals desire to leave these fields, including females and ethnic minorities. Indeed, their love and passion for Science are a source of motivation. On top of that, universities and companies implemented actions to attract and retain women in STEM.

At the educational level, these include information sessions, encouraging diversity in group work, initiatives allowing young girls to meet and exchange experiences, and networking.

At the corporate level, there are several initiatives, including positive discrimination, daycare, training, sponsorship and mentoring, the adaptation of equipment to all staff, and flexibility to achieve a certain work-life balance.

Part V: Discussion, limitations, and future research

5.1 General conclusion

This thesis examines the role of context on women's trajectories in STEM education and employment. We conducted qualitative research based on semi-structured interviews with 25 respondents, including white female students, ethnic minority students, white female professionals, and ethnic minority professionals, all in the STEM field. The goal was to understand, on the one hand, how racism and sexism might impact the experience of female students and STEM professionals. On the other hand, we had to investigate how the experience of minorities differed according to their ethnic origin.

Before going further in conclusion, it is crucial to present the contextual differences between Belgium and the USA to understand how they may impact the trajectory of women and minorities in STEM. Indeed, the United States, where most of our literature comes from, has been built by different waves of immigration, with a racially divided society, including more visible and frontal acts of racism, thanks to the segregation. American universities are costly and, therefore, quite selective at the educational level. Thus, competition and individualism are common among students, impacting the atmosphere and how students interact. Unlike USA, immigration is quite recent in Belgium, dating back to the 20th century. Society follows the "integration model," which implies a single society. Acts of racism are very subtle but severely punished. Finally, at the educational level, universities are affordable and allow anyone with a high school diploma to enroll. Solidarity and cooperation are encouraged among students, leading to a more friendly and welcoming atmosphere.

The literature review described the challenges faced by women and ethnic minorities in STEM. When comparing these challenges with those encountered by white females and ethnic minority students in STEM in Belgium, we discovered common challenges regardless of the context and the country. For instance, sexual and racial microaggressions, stereotypes, or sexist and racist discrimination are barriers women and ethnic minorities face in STEM in both countries. However, as mentioned earlier, these discriminations are subtle and less frontal in Belgium. Indeed, Ethnic minority students and professionals reported experiencing fewer obstacles compared to the theories presented in the USA articles. Therefore, their reactions when faced with these challenges are different. Some will be psychologically and morally impacted by it. Others perceive it as a challenge, and few minimize and trivialize it, especially minorities born and raised in Belgium, as they are less sensitive to cultural differences.

Researchers also presented a "cold and unwelcoming" climate in STEM fields, which is quite the opposite of what we found in our interviews. Although STEM fields are male-dominated, students and professionals reported studying and working in a positive and friendly environment where solidarity and mutual support are highly valued.

Interestingly, even among ethnic minorities, we discovered certain privileges such as being born and raised in Belgium, having light skin color, or a non-foreign sounding name. Indeed, ethnic minority women with light skin color recognize the privilege of their skin color and acknowledge that they experience less discrimination linked to it. The same goes for those with foreign-sounding names, as they might be privileged during CV screening in the recruitment process. Consistent with the literature review, we also found that ethnic minority black women are most affected by racism and sexism in STEM. Thus, they might be the most inclined to leave this field. Therefore, sexism and racism impact women's experiences in STEM; however, women and minorities certainly react to or face these challenges differently.

The Belgian environment seems to support women and minorities in STEM. Universities and companies have implemented actions to prevent women and ethnic minorities from leaving STEM fields. Nevertheless, it is essential to note that the subtle nature of discrimination and micro-aggressions encountered by women and ethnic minorities makes it challenging to address. Indeed, counteracting these kinds of discriminations, including identifying effective solutions, is difficult since they are less visible and extreme.

Finally, it is worth recalling that our research revealed that women and minorities already in the STEM domain hardly leave STEM fields despite the challenges mentioned previously. They believe leaving STEM fields is not the solution because women in other fields also encounter sexism and racism. This demonstrates that the underrepresentation of women and minorities in STEM is not due to women and minorities leaving the field. The problem lies in the choice of study for girls, who often do not consider studying in this field. Therefore, many things need to be done to improve and achieve gender and racial diversity in STEM

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5.2 Managerial implication for increasing diversity and inclusion in STEM

All the interviews and additional research we conducted showed that the problem is not in STEM but in attracting women and empowering them in science studies/careers.

5.2.1. Recommendations for Education System (Schools, High Schools, Universities)

Many speakers emphasized the **role of education** in career choice and orientation from an early age.

First, it is important to **train the first actors in the socialization of children**, namely teachers, but also parents on their own gender bias. We have thought of including "anti-bias" training in their teacher training courses to make them aware of the subject in the first place. However, this type of training cannot address all aspects of sexism. It is therefore important to complement this with concrete actions. **At the school level**, it is a question of exposing them to both "masculine" and "feminine" subjects, to stop systematically orienting young girls in care roles or literary subjects, judging their abilities for scientific subjects at a lower level. Also review educational textbooks, in order to limit the numerous sexist statements and examples that children are confronted with from an early age and that reinforce stereotypes.

At the school system level, starting in primary school, promote diversity in the educational system through the representation of different ethnicities in the fields of science (drawings, more inclusive exercise statements, openness to other cultures, etc.). As far as ethnic minority women are concerned, they generally face the same obstacles as white women with the added intersectional aspect of their ethnicity. The main issue for ethnic minorities is the lack of representations and role models.

Secondly, **at the secondary and higher education levels**, students have difficulty visualizing themselves in the scientific field because they do not realize the reality of the profession. Observation internships for secondary school students accompanied by an insertion internship for university students could help them get a first glimpse of the professional world of scientists. The internship culture is not particularly recognized, nor yet valued in our educational system. Moreover, the extracurricular environment.

At the **level of higher education**, universities must put in place more support for ethnic minority students. By setting up campaigns to fight against discrimination on university campuses, by sending out questionnaires to find out the difficulties encountered by these students to put in place things to fight against this phenomenon, by informing students about the rights they have in terms of discrimination, by setting up special cells and support mechanisms to which students can refer in case of problems.

In addition, many students we interviewed emphasized the importance of university life outside of the auditorium. University campuses remain places for students to interact and mix. Encourage extracurricular activities that promote meetings between students of all minorities and genders related to STEMS (conferences, company visits, networking evenings, workshops).

5.2.2. Recommendations for managers and organizations

We have identified that the predominantly white male STEM culture is entrenched in mores and tradition at the organizational level. Companies need to get to the heart of the matter by bringing visibility to the importance of diversity and inclusion in business. For this and as mentioned in the literature, managers of Belgian companies can implement **diversity and inclusion training** at work, not only for themselves but also for the employees to bring awareness in the unconscious bias they might still have. To avoid that only person who feels directly concerned by the problem participating, it would be wise to make these training compulsories. This could start by providing equal pay for men and women and to reduce or even eliminate the gender-based wage gap.

Companies need to implement a **fair recruitment process** based primarily on technical skills. Since STEM is a relatively technical field, it is easy to assess each candidate's skills through case studies and real-life situations.

It is essential to put women forward and to give them **more visibility**. It is also true for ethnic minorities. It is important to remember the societal benefits of evolving into a diverse team as mentioned in previous sections. This could start by promoting more women and ethnic minorities in top management positions. Even though positive discrimination remains a controversial practice, we believe that it can be a first step in changing this unequal system.

Many practices align with what is also in place in Belgian organizations, as mentioned by our respondents. These practices include **coaching, sponsorship, and mentoring** systems for women in companies. All these good practices need to be reinforced and shared between the different organizations through different networks. .

Data is a valuable tool for analyzing issues and policies. Companies need to survey their employees on their well-being at work to improve their well-being at work, especially for minorities in STEM.

5.2.3. Recommendation for Belgium government

The government could collaborate with companies by putting in place **financial incentives** to promote diversity and inclusion within Belgian companies. As mentioned by one of our respondents, by strengthening its gender budgeting policies by allocating part of its budget to invest in diversity and inclusion policies.

The government needs to strengthen its **policies and laws on discrimination in organizations** and work with business leaders to ensure that they are implemented and enforced in Belgian organizations. Sanctions must be applied equally to all Belgian companies. Furthermore, in terms of gender equality, it would be wise to strengthen the laws on equal pay for men and women to promote gender equality.

Finally, as mentioned by some respondents, some **infrastructures**, such as research laboratories, are not always adapted to all types of profiles. The government needs to work with people directly on the ground and concerned, such as women engineers for example, when it comes to investing in new infrastructure for scientific research.

5.3. Limitations of the research

While writing our thesis, we realized some limits in the theoretical framework because the existing literature presents studies done mainly in the USA. The other limits appeared during the data collection phase.

As said earlier, the first limitation was the lack of literature about Women in STEM in Europe. Our theoretical framework is based on research done in the US. Most of the papers looked at sexism in STEM. Nevertheless, little research has addressed the underrepresentation of women in STEM from an intersectional approach.

Since the beginning of our research, finding accurate and quantitative statistics about minorities in Europe has been challenging. It was not an easy task to make a complete comparison and analysis between the American literature and what was happening in Europe. Our Master's thesis is a premise, a first observation of the situation on the Belgian side regarding the realities of women and ethnic minority women in STEM. Thus, it would have been interesting to get more statistics and collect essential data to analyze it. We knew that this would be innovation and that we were starting from scratch.

The second limitation concerns data collection. We failed to get as many as possible ethnic minority respondents. It also reflects that few ethnic minority students are in STEM studies in Belgium. It was even more challenging to have ethnic minority professionals. We included ethnic minority male students and professionals to get more information. Besides, we only had French-speaking respondents. Therefore, we had to translate the quotes, and we cannot guarantee 100% that the translations reflect the words or ideas of the participants.

Finally, since we conducted online interviews, we encountered some technical issues during the interviews. It was sometimes difficult to hear what the respondents were saying, which might have led to some missing words in the transcriptions. In addition, since we were both doing our internships, we had to conduct the interviews after working hours. Thus, we sometimes had tired respondents who were unwilling to speak too much. Face-to-face interviews would have been good because they would have enabled us to analyze the respondents' body language.

5.4. Directions for future research

As mentioned above, this subject has not yet been fully explored in the European context. In our thesis, we have established a sort of groundwork for this research. However, it would be interesting to do much detailed analysis on this topic and possibly consider extending it to the European level to understand what the implications are at the European level.

Secondly, this study could be further developed by interviewing ethnic minority professional women who did STEM options at school but decided not to follow this path for their careers. Doing so would provide a different perspective from those who are still in STEM and give a better understanding of why they decide to leave. Similarly, it would be interesting to interview high school girls to understand better why they do not choose these options.

Finally, research could also be conducted to understand what kind of support or actions positively impact ethnic minority students' experiences in STEM. For example, this could include investigating the impact of gender or role model background. This can help to understand the role of representation for minority students.

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Appendix

Appendix 1: Interviews guidelines

Questionnaire pour les étudiants

Bonjour, nous sommes Syndia et Elisabeth et nous sommes étudiantes en Master 2 à la Louvain School of Management. Dans le cadre de notre mémoire commun de fin d'études, nous souhaiterions interviewer trente étudiantes ou professionnelles dans le domaine des STEM afin d'analyser et d'étudier l'expériences des femmes et plus particulièrement de celles issues de minorités ethniques dans le domaine. Il est important de souligner que l'identité des personnes interviewées resteront anonymes tout comme l'organisations dans laquelle elles travaillent ou étudient. Nous changerons ou n'indiquerons pas les informations susceptibles d'identifier la personne. Nous poserons des questions au sujet de votre carrière, de vos études, de votre parcours professionnel ainsi que des obstacles rencontrés liés à votre genre ou à votre ethnie dans le domaine des STEM.

Il est également important pour vous de savoir comment les informations seront utilisées. Dans un premier temps, nous vous poserons une série de questions que nous retranscrivons par la suite. Ensuite, nous citerons dans notre analyse les parties qui démontrent une contradiction ou similarité avec les autres répondants afin d'en tirer les meilleures analyses et conclusions. Les résultats de notre recherches seront partagés avec tous les participants le désirant mais contiendront uniquement le résultat

Afin de mener à bien cette interview, nous souhaiterions vous demander la permission d'enregistrer cette interview qui sera supprimée une fois que celle-ci sera retranscrite et que notre mémoire aura été défendu. À ce stade-ci, avez-vous une quelconque question pour nous ?

Enfin, si vous ne souhaitez pas répondre à une question, il est de votre libre choix de ne pas y répondre. Il n'y a pas de bonne ou de mauvaise réponse étant donné que nous souhaiterions parcourir votre expérience personnelle sur le sujet. De manière plus pratique, l'interview durera entre 45 minutes et 1h.

Ice breaker

Dans un premier temps, nous allons vous laisser choisir une fausse identité. Vous pouvez choisir le prénom que vous désirez (prénom que vous avez toujours rêver d'avoir, le nom d'une personne de votre famille, d'un.e ami.e,

Est-ce que vous permettez que l'on se tutoie? Etant étudiantes nous-même et ayant une différence d'âge moindre, c'est toujours plus agréable de pouvoir se tutoyer.

Situation actuelle

- Pourrais-tu nous en dire plus par rapport à ta situation actuelle?
 - Où est-ce que tu étudies? (on ne veut pas connaître le nom de l'université mais plutôt de savoir dans quelle environnement l'étudiant étudie (haute école, université, formation, etc...))
 - Qu'est-ce qui a influencé ton choix d'université ou de haute école?
 - Quel programme étudies-tu?

- En quelle année es-tu?

Choix d'orientation

- Comment as-tu choisi tes études, quels ont été les facteurs qui ont influencé ce choix?
- Quel métier voulais-tu exercer en grandissant et pourquoi?
- Quelles options suivais-tu durant tes deux dernières années du secondaire?
 - Comment as-tu choisi ces options? Quels facteurs ont influencé ton choix (parents, amis, professeurs,...)
- Y'a-t-il un lien entre tes options du secondaire et tes études actuelles? Pourrais-tu expliquer en quoi ce lien existe?
- Quelles idées te faisais-tu par rapport à ce domaine d'étude avant de décider de t'y orienter?
- As-tu observé une division marquée en termes de genre et/ou ethnie par rapport au choix d'options? Par rapport à la composition des classes?
- Connais-tu des femmes influentes exerçant dans ton domaine d'études? Si oui que t'inspirent t'elles? sont-elles pour toi une source de motivation ou d'encouragement?

Influence de la famille et de l'entourage dans le choix d'études

- Pourrais-tu nous parler de la situation de tes parents?
 - Quel est leur niveau académique et qu'ont-ils étudié?
 - Quel métier exercent-ils actuellement?
 - Que pensent-ils de ton choix d'étude?
 - Tes parents ont-ils influencé ton choix d'études? Si oui, de quelle manière?
- Pour les étudiantes de minorités:
 - Que pense ton entourage/ta communauté de ton choix d'études? T'encouragent-ils? Si oui, comment? Si non, pourquoi ne t'encouragent-ils pas?

Barrières pédagogiques

- Comment évaluerais-tu le niveau de difficulté de tes études sur une échelle de 1 à 10? et pourquoi?
- Comment évaluerais-tu l'environnement pour les étudiantes au sein de ton programme dans ton institution universitaire?
 - Quelles sont les difficultés rencontrées dans le cadre de tes études?
 - As-tu déjà voulu changer de programme? Si oui pour quelles raisons? Pour quelles études?
- Selon toi, est-ce que ton université investie beaucoup de temps et de ressources dans la construction d'un environnement encourageant pour les femmes et les minorités ethniques dans ta faculté? Peux-tu nous expliquer comment?
 - Quel soutien aurait dû être mis en place pour vous aider?
- Quelle relation entretiens-tu avec tes camarades de classe/auditoire (solidarité, entraide ou c'est plutôt tendue, etc..)
- Quelle est la répartition de genre des étudiants dans ta classe/auditoire? y'a-t-il une disparité de genre?
 - Si oui, comment vis-tu cette disparité de genre dans ta classe?
- Comment est-ce que tu perçois la relation entre les professeurs/membres de la faculté et les étudiantes?

- Quelle est la répartition de genre des professeurs au sein de ta faculté?
 - Cette répartition constitue-t-elle un frein pour ton avancement dans ce domaine ?
- As-tu l'impression d'être soutenue par les membres de la faculté?
- Existe-t-il des programmes de coaching ou de mentorat spécifiquement pour les femmes ? Et que pensez-vous de l'idée d'être soutenue par un mentor?
- Êtes-vous sujet à la réalisation de travaux de groupes ?
 - À quelle fréquence?
 - Comment se déroulent-ils ?
 - Les professeurs vous assignent-ils des groupes imposés ou pouvez-vous les constituer par vous-même ?
- As-tu réalisé un stage dans le cadre de tes études? (pour les étudiants en fin de BAC/Master)
 - Si oui, as-tu eu des difficultés à trouver un stage? Pourquoi?
 - Comment s'est-il déroulé?

Diversité et inclusion

- Comment décrirais-tu ton background culturel et ethnique ? (Donner nos exemples personnels puis demander l'avis de l'étudiante) / de manière générale: qu'est-ce qu'elle pense du manque de femme dans les STEM et c'est dû à quoi?
- Y'a-t-il une disparité ethnique dans ton auditoire/ta classe?
 - Si oui, quelles sont selon toi les raisons de cette disparité?
 - Comment vis-tu cette disparité ethnique ?
- De quelle manière ton ethnicité et/ou ton genre impacte ton expérience en tant qu'étudiante dans les STEM ?
 - As-tu déjà ressenti une différence de traitement par rapport à tes camarades:
 - *Pour les femmes blanches*: Hommes ?
 - *Pour les femmes de minorités*: Femmes Blanches? et/ou Homme?
 - As-tu des exemples de situations dans lesquels tu t'es sentie discriminée étant donné ton genre ou ethnie dans ta faculté ? (Par exemple, propos déplacés ou malveillant venant d'un camarade ou d'un professeur). Peux-tu nous expliquer en détails ce qu'il s'est passé?
- Selon toi, penses-tu que l'ethnie constitue un frein dans l'obtention d'un diplôme dans le domaine des STEM ?
 - Si oui, de quelle manière ?
- Estimes-tu que ta faculté soit inclusive :
 - En termes d'ethnicité ?
 - En termes de genre ?
- Selon toi, que pourrait mettre en place ton université/ta faculté afin de promouvoir une meilleure inclusion des étudiantes issues de minorités ethniques ?

Questionnaire pour les femmes professionnelles

Bonjour, nous sommes Syndia et Elisabeth et nous sommes étudiantes en Master 2 à la Louvain School of Management. Dans le cadre de notre mémoire commun de fin d'études, nous souhaiterions interviewer trente étudiantes ou professionnelles dans le domaine des STEM afin d'analyser et d'étudier l'expérience des femmes et plus particulièrement de celles issues de minorités ethniques dans le domaine. Il est important de souligner que l'identité des personnes interviewées resteront anonymes tout comme l'organisation dans laquelle elles travaillent ou étudient. Nous changerons ou n'indiquerons pas les informations susceptibles d'identifier la personne. Nous poserons des questions au sujet de votre carrière, de vos études, de votre parcours professionnel ainsi que des obstacles rencontrés liés à votre genre ou à votre ethnie dans le domaine des STEM.

Il est également important pour vous de savoir comment les informations seront utilisées. Dans un premier temps, nous vous poserons une série de questions que nous retranscrirons par la suite. Ensuite, nous citerons dans notre analyse les parties qui démontrent une contradiction ou similarité avec les autres répondants afin d'en tirer les meilleures analyses et conclusions. Les résultats de notre recherches seront partagés avec tous les participants le désirant mais contiendront uniquement le résultat

Afin de mener à bien cette interview, nous souhaiterions vous demander la permission d'enregistrer cette interview qui sera supprimée une fois que celle-ci sera retranscrite et que notre mémoire aura été défendu. À ce stade-ci, avez-vous une quelconque question pour nous ?

Enfin, si vous ne souhaitez pas répondre à une question, il est de votre libre choix de ne pas y répondre. Il n'y a pas de bonne ou de mauvaise réponse étant donné que nous souhaitons parcourir votre expérience personnelle sur le sujet. De manière plus pratique, l'interview dure entre 45 minutes et 1h.

Ice breaker

Dans un premier temps, nous allons vous laisser choisir une fausse identité. Vous pouvez choisir le prénom que vous désirez (prénom que vous avez toujours rêver d'avoir, le nom d'une personne de votre famille, d'un.e ami.e,

Situation actuelle

Dans un premier temps, nous souhaiterions avoir une idée de votre situation actuelle par rapport à votre carrière professionnelle :

- Dans quel type de compagnie/institution travaillez-vous ? (Multinationale, startup, enseignement, ...)
- Dans quel domaine technique travaillez-vous et depuis combien de temps ?
- Pouvez-vous nous expliquer brièvement ce que vous faites au quotidien dans votre fonction ?
- Comment vous sentez-vous dans votre position actuelle ?
- Quelles sont vos challenges au quotidien dans le cadre de votre fonction?
- Comment décririez-vous votre background culturel et ethnique ?

Education et orientation

- Qu'est-ce qui vous a poussé à étudier dans un domaine technique et poursuivre une carrière dans les STEM ? Avez-vous été inspiré par quelqu'un
- Que saviez-vous de votre domaine STEM lorsque vous étiez enfant ?
- Quelle était votre majeure à l'Université ? Dans quelle faculté étiez-vous ?
- Avez-vous rencontré des difficultés durant vos études dû au fait que:
 - *Pour les femmes blanches* : vous étiez une femme dans un environnement majoritairement masculin ?
 - *Pour les femmes de minorités ethniques* : vous étiez une femme de minorité ethniques dans un environnement majoritairement blanc ?
 - Pensez-vous que votre expérience à l'université aurait été différente si vous aviez été:
 - un homme (pour les femmes blanches) ?
 - une femme blanche (pour les femmes de couleurs)
 - De quelle manière?

Recrutement et sélection

- Comment s'est déroulée votre recherche d'emploi une fois diplômée ? Avez-vous éprouvé des difficultés à trouver un emploi ?
 - Quels types de difficultés ? (manque de réseau, pas d'expériences, lié à votre statut...)
- Pouvez-vous nous décrire brièvement comment s'est déroulé votre processus de recrutement ?
 - Processus compliqué? Équitable?
 - Pensez-vous que votre genre ou votre ethnie a joué un rôle pour celui-ci?
- Savez-vous si l'organisation a des objectifs en termes d'équilibre entre les sexes ou l'ethnicité? (par exemple, un recrutement actif de plus de femmes/minorités ces jours-ci ?)
- Une fois recrutée, avez-vous eu droit à un accompagnement personnalisé?

Relation sociale et networking

- Que pouvez-vous nous dire par rapport à votre environnement de travail ? S'agit-il d'un environnement de travail compétitif ?
- Quelle relation entretenez-vous avec vos collègues?
 - Y'a-t-il des collaborations entre les femmes/ entre les femmes et les hommes au sein de l'entreprise dans laquelle vous travaillez? (entraide, communication facile...)
 - En tant que femme de minorité ethnique, comment est la relation avec vos collègues ? est ce que vous avez l'impression d'être traité différemment ? (commentaires ou propos mal placés)
- Votre organisation offre-t-elle des possibilités formelles de réseautage (par exemple, des événements de réseautage, des activités de consolidation d'équipe, ...)
- Votre organisation offre-t-elle un programme de mentorat spécifiquement conçu pour les femmes ?(par exemple, en mettant en contact les plus anciennes et les nouvelles recrues ou en assignant un coach aux nouvelles employées, ...)

Carrière

- Votre situation familiale (enfant, mariage) a-t-elle déjà influencé votre carrière professionnelle? si oui, de quelle manière?
- Pensez-vous qu'il est possible d'avoir un équilibre entre la vie privée et la vie professionnelle dans le métier que vous exercez? Pourquoi?
- Avez-vous déjà pensé/fait un break dans votre carrière dans les STEM ?Pour quelle raison ?
- Comment envisagez-vous l'évolution de votre carrière ?
 - Envisagez-vous un poste hiérarchiquement plus élevé? Pour quelles raisons?
 - Envisagez-vous ou avez-vous déjà envisagé de changer de domaine?
 - Que feriez-vous, le cas échéant, différemment dans votre progression de carrière maintenant que vous pouvez y repenser ?
- Pensez-vous que le genre joue un rôle dans le processus d'évaluation des performances et de promotion ? Pourquoi?
- D'après vous, avez-vous bénéficié d'une promotion suffisante dans votre organisation? Pourquoi ?
- Quelle est l'importance du réseautage dans le processus de promotion et d'avancement de carrière ici?
- Si vous deviez conseiller les jeunes filles qui aspirent à poursuivre une carrière dans ce domaine, que leur diriez-vous?
- Dans un monde parfait, à quoi ressembleraient l'apprentissage et le développement des femmes dans les STEM ?

Diversité et Inclusion

- Selon vous, votre environnement de travail est-il diversifié :
 - En termes de genre ?
 - En termes d'ethnicité ?
- À votre avis, est-il plus difficile pour les femmes que pour les hommes de faire carrière dans le secteur des STEM? Pourquoi?
- Quels types d'obstacles les femmes rencontrent-elles dans le secteur, que les hommes ne rencontrent pas ou dans une moindre mesure?
 - Ces obstacles sont-ils spécifiques au secteur des STEM? Comment ?
- Avez-vous déjà reçu des commentaires ou des réflexions liés à votre aptitude/capacité au travail?
- *Pour les femmes blanches*: avez-vous déjà eu l'impression d'être traitée différemment d'un collègue masculin dans votre organisation ?
- *Pour les femmes de minorité ethnique*: avez-vous l'impression de devoir faire plus de preuves que vos collègues masculins/ ou femmes blanches parce que vous êtes une femme de minorité ?
- Qu'est-ce qui, selon vous, constitue un échec majeur dans la réalisation de la diversité des genres et culturelles dans les STEM? Comment pensez-vous que cela puisse être éliminé ?
- Qu'est-ce qui, le cas échéant, a été fait par les Ressources Humaines en matière d'inclusion de genre et culturelle pour aider les femmes professionnelles ?
- Que pensez-vous des mesures mises en place pour favoriser l'égalité de genre et/ou ethnique au sein de votre environnement de travail ?

- Avez-vous déjà reçu une formation ou des aménagements sur votre lieu de travail parce que vous êtes une femme et/ou de minorité ethnique dans ce domaine et, si oui, pouvez-vous décrire comment cela s'est passé ?
- Comment ces formations ou aménagements vous ont-ils fait sentir en termes de confiance ou de sentiment d'appartenance au travail ?
- En tant que femme ayant fait une carrière dans les STEM que pensez vous qu'il est possible de faire au niveau européen pour pallier à ce problème de manque de femme/minorité ethnique dans les domaines scientifiques?

Fin de l'entretien

Nous avons maintenant abordé de nombreux sujets différents. Avant de terminer, je voudrais vous demander s'il y a quelque chose que vous pensez qu'il est important pour nous de savoir en ce qui concerne l'inclusion des femmes dans ce domaine que vous avez choisi, et dont nous n'avons pas parlé dans cet entretien ?

Nous vous remercions pour votre précieux temps.

Abstract

This thesis examines the role of context on women's trajectories in STEM (Science, Technology, Engineering, Mathematics) education and employment in Belgium. We conducted qualitative research based on semi-structured interviews with 25 respondents, including white students, ethnic minority students, white professionals, and ethnic minority professionals, all in the STEM field. The aim was to understand, on the one hand, how racism and sexism might impact the experience of female students and STEM professionals. On the other hand, we examined how the experience of minorities differed according to their ethnicity. Much research has been conducted on women's underrepresentation in STEM. However, most of it has been conducted in the United States. Few of said research has explored this issue from an intersectional approach. Therefore, we will provide some background work on the experiences of women and ethnic minorities in STEM in Belgium with an intersectional perspective.

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