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What stands behind the balanced ratio of male/female students in the Algerian STEM education despite the country's low gender equity?

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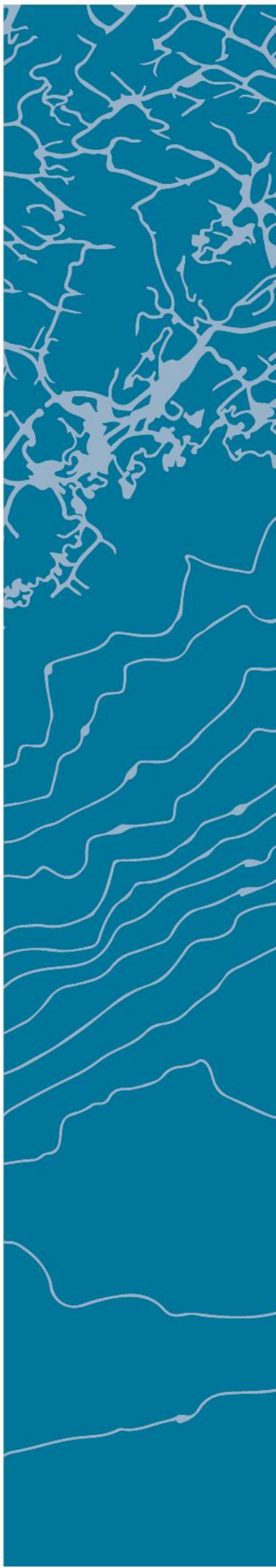

Abstract

The study's main objective is to elucidate the reasons behind gender equality in the STEM education in the Algerian universities despite the lack of gender equity noticed in society. This study starts from Stoet and Geary's findings in regard to the gender equality paradox in STEM, which considers that Algerian women are forced to choose to pursue STEM field studies in university in a look for better economic prospects. However, through a mixed qualitative and quantitative methodology that includes 51 surveys and five semi-structured interviews, the study shows that Algerian women take into consideration other elements when choosing a degree, such as their results in the Baccalaureate, the suitability of the skills acquired during their high school for their choice in university, and the prestige of their future major or university.

We conclude that the Algerian education system has initiated a university orientation system that encourages continuity and pushes fresh university students to stick to fields that are closely similar to their high school specialization.

While discussing the criticism Stoet and Geary's theory of gender equality paradox has faced, this study looks into the causes of the gender gap in STEM education and the possible solutions. Four major perspectives on the issue of gender misrepresentation in STEM are identified. The first one focuses on individual abilities, such as reading and spatial skills and performance at school, the second one looks into the social dimensions influencing decision-making and behaviours both in STEM and in the general society, the third perspective studies the workplace environment, and finally, the fourth perspective examines how women's self-image and internalized beliefs affect their career choices.

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Finally, I am very grateful for Norway's free education policy that allows hundreds like me to access quality higher education regardless of nationality and residency status. May it continue to produce outstanding research, scholars, and human beings.

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1 Introduction

1.1 Background and Rational

The different indices the United Nations (UN) has developed to measure gender inequalities have proven to be an essential tool to measure the progress made in the field of gender equality and to motivate different nations to set up policies that would improve gender equality in various areas. Yet, these indices have revealed certain contradictions between what numbers say on one side and what reality shows on the other. This is precisely the case of Norway, which is on the top of gender equality according to the UN's Gender Inequality Index (GII) results, while in reality, it struggles to have gender equality at the university level, and later, in the job market as well, as it mirrors the same gender distribution disparities seen in higher education.

In Norway (GII = 0.044) (UNDP, 2019), disparities in men's and women's outcomes in the professional life are still noticeable. In 2018, despite females students making up the majority of the student body in the country (174.478 vs 118.809) (Statistics Norway, 2019), fewer female students (34.1%) chose to study natural sciences, crafts, and technical subjects compared to their male counterparts (65.9%). Disparities are even more significant when comparing numbers of female and male students choosing military colleges for their higher education (580 male students vs 111 female students). Unfortunately, this is not the case in Norway alone. The trend persists across most countries with what is considered a "good" GII index such as Norway's follow Nordic countries such as Sweden and Denmark. According to Talks et al. (2019), it is a general observation across Europe where no more than a $1/5^{th}$ of computer science graduates are women. In the UK, 89% of the engineering workforce was male in 2017 (The Guardian, 2017). A survey by British Gas showed that 48% of young women do not even consider science, technology, engineering, and mathematics (STEM) fields when choosing a career. Sjøberg and Schreiner (cited by Bøe, Henriksen, Lyons, Schreiner, 2011, p. 39) called this a "flight from science". They described it as a global phenomenon. Stoet and Geary (2018) have noticed in a paper about the gender equality paradox in STEM education that the more gender-equal a country is, the more significant the gender gap in the STEM education and careers. In the same study, they suggest that a pressure related to life-quality in countries considered less gender-equal pushes girls and women to get more involved in STEM subjects in their look for a better financially rewarding occupation. This, in their opinion, explains the equal numbers of STEM graduates between males and females in countries like

Algeria, where the GII score (0.443) is much lower than that of Norway. Stoet and Geary's assumptions have faced many critiques in relation to the methodology and the data used as a basis for the study they conducted. Richardson et al. (2019) criticized the use of the Global Gender Gap Index (GGGI) and the UNESCO tertiary degree statistics, deeming them inappropriate for studying individual predispositions, which should be measured using a psychometrically sound scale of people's perceived or actual gender inequality in relation to their STEM preferences. We dive into more details of these critiques and Stoet and Geary's arguments against them under the literature review; nevertheless, Stoet and Geary's assumptions remain intriguing to explore within the Algerian context.

There has been a long history of gender equality studies in developed countries. Still, very little has been investigated in countries like Algeria, where gender equality and feminism issues are often studies within the scope of citizenship, political representation, and family law. All of which are matters where women are constantly holding the shorter straw. It is this gap that this study is trying to fill by investigating the reasons behind the positive outcome of the education policy/system in its gender ratio and the equal gender representation across most fields of education in Algerian universities. Is Stoet and Geary's assumption right? What considerations do Algerian students have when choosing their degree? Do those considerations differ between boys and girls? Understanding the motives and considerations of Algerian students, especially female students, would allow us an understanding of social dynamics in Algeria that might shed light on the elements enabling gender equality in the STEM education in developing countries. Such results have the potential to spill over the work environment and provide a glimpse into the STEM job market gender distribution in the developing countries.

1.2 Research Problem, Research Question, and Study Objective:

This study aims to research whether life-quality pressures in Algeria push girls and women to choose STEM fields as a subject at the university level in a look for financially more rewarding occupations. In the process of this investigation, the hope is to shed light on what elements do motivate women's choices when picking a field of study at the university level in Algeria. This will be investigated through the following research questions:

1/ What considerations do female Algerian students have when choosing their university degree?

2/ What/who influences their choices?

3/ What kind of policies implemented by the Algerian government could have influenced the male/female ratios in STEM fields at the higher education level?

1.3 Geographic Study Area and Context:

Algeria is a country of about 42 million inhabitants, 75% of which are under the 35 years old. It situated in North Africa and counts 106 public higher education institutions in 2018, compared to 3 in 1962, the year it got its independence from France. Students in Algeria have some great benefits, especially if compared with other countries in the region. Education is totally free, including higher education, and students receive a stipend every three months. According to an interview with the Algerian minister of higher education and scientific research, Taher Hejjar (Bouthelji, 2018), 80% of the students in Algeria benefit from scholarships, and about 50% live in free university housing. He also highlighted the high number of female students compared to male students in Algerian universities. Female students represented no more than 21.2% of the total students' body in Algeria in the school year 1962/1963, but in 2017 they accounted for 62.5% of the number of registered students and 65.6% of the total degree-holders in Algeria. As for PhD preparatory studies, girls represented 52.5% of the number of students. The minister also explains that out of the 60,000 university teachers of various ranks, women represent 47% (Bouthelji, 2018).

1.4 Overview of the education system in Algeria:

By law, education is considered compulsory from the age of six until 16, with the possibility of enrolling some kids at five or four if judged fit for the school. The education system in Algeria has gone through many stages since the country's independence in 1962. It is free for everyone living in the country, and the different governments have insisted that it will stay that way, spending more than 1/5 of the state's budget to keep it running for the 10 million students it serves, about 10% of the country's population (UNICEF, 2014). It is divided into four different parts: The pre-school for kids under the compulsory school age (different from kindergarten available for all ages outside primary school), basic (includes primary and middle school), secondary (high school) or vocational (trade school), and higher education in the form universities, national schools of higher education (Ecole National) and national institutes (Institut National). The access to higher education is possible after passing a national high school examination called Baccalaureate, an equivalent to an A level. Right after its independence, Algerians could choose between three higher education institution available in the country's biggest cities: Algiers in the center, Oran in the west, and Constantine in the east.

They counted less than 2000 students at the time, of which 1% were female (UNICEF, 2014). It is only after the Ministry of Higher Education and Scientific Research was established, in the 1970's, that universities saw a gradual change.

The Algerian educational system structure was inspired by the French system for obvious historical reasons dating back to the French colonization of North Africa. The French colonial presence in Algeria last from July 1830 to July 1962. Like in the rest of the world, Algeria has followed the globalisation of the higher education system by introducing the BMD system (3-year Bachelor, 2-year Master, 3-year Doctorate) in 2004, moving gradually away from the previous system (4-year Licence, 2-year Magister, 3-4-year Doctorat) to the BMD (3- year Bachelor, 2-year Master and 3-year Doctorate). The Law No. 99-05 of 18 Dhou El Hidja 1419 of 4 April 1999 provided the legal framework for the allocation of these three higher education degrees, with the exception of studies in the fields of medical science (medicine, pharmacy and dentistry), architecture, veterinary sciences and agronomic sciences, which are taught on the previous higher education system to this date.

Higher education is primarily public. It is provided through universities, academic centres and schools. It also offers degrees provided by the Institutes of Sciences and Applied Techniques. These are created within the universities and are meant to train middle managers to cover the job market needs based on field surveys. Private higher education is still new in Algeria, it was only established in 2014 and counts eleven higher education institutions. These private institutions can not provide instruction in the medical field. Therefore, the higher education system is public in its majority, allowing the Algerian government to have complete control over it and an easier implementation of policies without much resistance from what could constitute for-profit interests.

1.5 University Orientation:

Access to higher education is organised through provisions provided by a preregistration and orientation circular every year. The circular establishes the conditions needed to access the faculties of the different universities and other higher education training institutions. The students' orientation to higher education, on the other hand, is based on a strict classification of the wishes expressed by the students, their baccalaureate series (the Algerian university entrance exam), the general average obtained at the entrance exam, the reception capacities of the different higher education institutions, the geographical district of the Baccalauréat holder,

and with no considerations for the student's age or gender. Once a student has obtained his/her baccalaureate in Algeria, they are allowed to pick 10 majors, but not the institution where to study. That choice of institution is based on the future student permanent residency (or rather that of his parents or legal guardians). Exceptions are made for majors taught in a limited number of universities or majors taught in Higher Schools (different from and more prestigious than universities), where the competition on entrance would be at the national level and not regional. This includes higher schools, such as the Ecole Superieur d'informatique (The higher school of IT), and specialties like oil production engineering and drilling engineering which are only taught in the University of Boumerdes (50 km east of the capital), and the University of Ouergla (800 km south of the capital). Orientation and access to some faculties might be subject to other condition, such as the grades obtained in the core subjects, while access to some fields might require the presentation of a good health certificate or an interview with a panel. Within the BMD structure, education is measured in credits and not in years of study like it was the case previously. Students must obtain 180 credits to get a bachelor's degree, and 120 credits after the bachelor's degree to obtain a master's degree.

1.6 Women's position in the Algerian Society

a/ The historic change in the Algerian society post-independence:

To get a grasp of women's position in the Algerian society, we need to first understand the society's economic organization and the way in which Algerian families are organized. From an economical point of view, it is worth pointing out, that in the first ten years that followed the Algerian independence the majority of the population, estimated at around 10 million in 1962, sustained a life based on agriculture in the countryside and rural areas of the country away from cities. For generations, many have worked as "Khammas", a term used to describe agricultural workers on colonial farms in Algeria, while however the biggest share were peasants who were reduced to their livelihoods within the agro-pastoral culture that fed into the subsistence economy strategy of the Algerian government following the independence (Djerbal, 2004). A minority of the population living in towns worked in factories inherited from the colonial era.

When examining the societal structures, the traditional Algerian society was predominantly shaped by the extended patriarchal family (Khodja, 1982). It resembles "a collectivist form of ownership and exploitation of the means of production" (Khodja, 1982, p. 481). Under this social organization, production units, like a farm or a peasant's house, are a place of residence,

production and of marketing where all members of the extended family are expected to contribute in a way that supports the entire production process. In the hierarchy of this organization or family structure the father holds the role of a manager with the power to decide how to use the profits from the production that all extended family members contributed to, distributes the tasks among family members and takes care of all aspects of marketing, exercising, as a result, a total authority over the younger male members of the family as well as over their wives and children (Khodja, 1982). This extreme form of centralization of all family decision making processes and the control over resources in the hand of the eldest male of the family, often the father or the eldest brother in his absence, naturally allows for his authority to go beyond the control over production to include control over the private lives of the whole extended family members. Under this family structure of collective life women's work is looked at as supportive to the productive activities of the family (Khodja, 1982). Depending on the regional contexts affecting production opportunities where the family is established, women's activities range from picking olives, taking care of the family's animals, gathering wood, or churning milk, among other chores available within the perimeter of the household. Such activities, although essential in the family's production work, is considered secondary work by men who refuse to do it, but remains "no less tedious and repetitive, and much less creative and rewarding than that which the men keep for themselves" (Khodja, 1982, p. 481).

With the newly introduced economic measures, the process of nationalization of properties that belonged to Europeans during the colonial era, as well as the increasing wave of social policies of the 1970s, the number of paid workers in Algeria increased significantly along the growing monetary economy of the country. As a result, a huge movement of population from the countryside to the cities took place at a sustained pace across several years ensuring the need of the new Algerian economy in terms of workforce was met. The mass of increasing salaried workers was divided into two cores: the "colonial" core which had been forced to internalize the rules and values of the European industrial system, and the "post-independence" core, which is rather linked to the modalities and traditions of rural work and traditional family values (Djerbal, 2004). The movement from a traditional countryside environment to the more Europeanized city environment allowed these two cores to melt into each other. This industrialization trend played an essential part in gradually destroying the traditional modes of production and life under the extended patriarchal family structure. The ongoing industrialization hand in hand with urbanization introduced for a larger portion of the

population a new way of life and production by separating the place of production from that of residence. The emergence of an employment market offered an alternative to the younger family members, especially women, to get out of the control of the eldest male family member's authority which has progressively eased the breakup of the traditional Algerian family structure. Fathers lost their unquestionable authority over sons and brothers, who can now find other sources of work with a more stable income that they can freely make use of. Women in towns and in the countryside now had the opportunity to also offer their services as well, putting in motion a change from an extended family structure towards a nuclear family structure composed of a married couple and their children. The focus now begins to shift towards cohesiveness of the nuclear family and taking care of the kids instead of the preservation of the village or the tribal solidarity (Khodja, 1982). Consequently, Algerian women's role in the country's economy has become more important. As a result, the control of men over women's life was reduced as females increasingly could access to the employment market, which consequently was affecting the traditional male identities based on men's ability to provide for the family. This shift in gender roles reduced men's control over women, weakened their power and took away their right to give orders. Nevertheless, the old Algerian mentality linked to the domination of the father over the women and younger males in his family persists and the roles assigned to men and women remain strongly part of the Algerian subconscious, which in the 1980s and following decades affected the nature of personal and family laws suggested by the Algerian parliament.

b/ Women's role between conservative ideals and needs of industrialization.

Algeria's need to build a developed society under the socialist principles chosen by the early Algerian governments post-independence required the economic emancipation of women to make use of the full potential of the Algerian resources and economy. In order to achieve that goal, this would have required the state to adopt a more forward-thinking approach to the role of women and their relationship with men. However, right after independence, in an attempt to gain more legitimacy, the Algerian regime established the concept of Islamic socialism that mixes Islamic principles with its relatively modernist and secularist discourse in the hope to appeal to the crowds of common people. This approach allowed a large space for the growth of Islamism that pressured the regime to promote an Arabization agenda and gained a large influence over public education and the state's bureaucracy, allowing the members of the Islamic movements to grow to become guardians of morality in the Algerian society (Ghanem, 2019). Consequently, the Islamists were able to further spread their ideology among young

Algerians in mosques and universities despite remaining unable to take control of the political power in the country.

The mix of persisting traditional gender roles in the Algerian subconscious, and the growth of the influence of Islamism on the Algerian masses, hampered the positive effects of the country's industrialization on women's role and rights. As a result, the Algerian lawmakers failed to put in place laws that would support this new trajectory towards more gender equality and active women's participation that the economic change have previously initiated.

The 1982-1984 Algerian parliament, the National Popular Assembly (NPA), adopted a personal status bill that would establish for the first time laws and regulations that would determine domestic relationships and "women's status as wives and mothers under the guardianship of husbands and fathers" (Cheriet, 1996, p. 24) as part of the regime's populist discourse that makes use of socialism, Islam, and traditional communitarianism to gain further legitimacy among the masses (Ghanem, 2019). According the Cheriet (1996) the new bill, along with others such as article 2 of the constitution that establishes Islam as the religion of the state, provided a legitimacy for conservative claims against the modern ideal of citizenry that would put women in an equal position to that of men. While Algerian women were set free economically thanks to an increasing access to the employment market generated through policies furthering the industrialization of the state, simultaneously, other state policies managed to limit the legal status of women to a domestic decision maker. The 1982 bill of the Family Code consigned women's status and preserved a male dominant patrilineal family structure. It had also introduced limitations to women's participation in the public spheres by making their right to work conditional to their husbands' permission of activities outside the family household.

Despite the withdrawal of the 1982 Personal Status bill due to large protests that followed from Algerian activists objecting such a retrograded bill, more and more conservative voices called for a family and personal status bill based on Islamic Shari'a and Algerian traditions, "especially those pertaining to the predominance of kin over individual, in particular over individual females" (Cheriet, 1996, p. 26). Two years later, on June 9, 1984, the Family Code was enacted as a law. It reduced women's agency and made her fully dependent on men in marriage, divorce, legal representation, and in matters of inheritance. Consequently, to this date, Algerian women are not able to marry or divorce just by themselves and are always in need of a male authority to get such personal life matters done. Overall, the set of laws under

the Family Code reinforced the dominant status of men over women in a clear contradiction to Article 29 of the constitution that establishes full equality of all Algerian citizens equal before the law and “No discrimination shall prevail because of birth, race, sex, opinion or any other personal or social condition or circumstance". Still, Article 29 and Article 2 of the Algerian constitution that declares Islam as the religion of the state, often cause a debate between those who wish to use Shari’a law to maintain social discrimination against women and strengthen the dominance of men, and those calling for a more equal society regardless of gender.

However, the 1984 Family Code was established based on the Islamic Shari'a law as explained and understood by scholars from the eighth and twelfth centuries interpretation of Qur’anic texts. The only exception was the part in relation with polygamy which made the consent of the first wives a condition for the husband to be able to remarry a second, third, or a fourth wife. Article 8 of the Family Code states that contracting marriage with more than one wife is allowed within the limits of Shari'a, that puts the cap at four wives only, if the motive for polygamy is justified and the conditions of equal treatment between all wives is possible, and only following a consultation of the previous and future wife who can sue the husband or ask for divorce if the husband happens to disregard her consent to remarry. The original Qur'anic verse, chapter 4, verse 2, the original source of this legislation, does not put the consent of the previous wife (or wives) as a condition for polygamy: “If you fear that you cannot treat orphans with fairness, then you may marry other women who seem good to you: two, three or four of them. But if you fear that you cannot maintain equality among them, marry one only, or any slave girl you may own. This will make it easier for you to avoid injustice”, (Quran, chapter 4, verse 2). While this could be considered a “little win” for the Algerian women that would give them more power than they had before by allowing them a right to divorce if they were not in favor of the polygamous marital relationship of their husbands, simultaneously article 53 of the Family Code keeps the control over divorce in the hands of the husband while wives have the right to "request to be made divorced" by husbands through a judge. Even this little access to the right to divorce given to women was contested by some parliament members who argued that polygamy cannot be used as a reason to request to be divorced, since polygamy is a religious right legalized by Shari'a (Cheriet, 1996). Further widening the rights gap between men and women in Algeria, Algerian women are still treated as legal minors no matter their age. While a man can marry freely without needing anyone’s approval, the Algerian Family Code does not give that same right to women and forbids then from marrying without getting

a consent from a legal male guardian (a father, a brother, or an ancle), and in the case where a woman does not have a legal male guardian, it is for the court to appoint one for her.

c/ Algerian women's rights today

Between their traditionally established social role in the family household and the growing employment opportunities thanks to the industrialization of the country, Algerian women find themselves stuck between two options. If they decide to strictly stick to their role as housewives and not participate in the employment market and work outside the household, then they automatically are limited to a role with barely fulfilling daily chores with a total economic dependence on their husbands that would ruin them in the event of a divorce, and with less leverage if the husband ever decides to start a polygamous marital relationship. Furthermore, by staying away from any independent productive activities, women would have less power to push towards more rights, better status, and more emancipation in general.

On the other hand, if they decide to pursue a career outside the family household, this would be dependent on the husband's approval and if allowed, women would be doubling their workload since their work outside the household does not relieve them from their traditional role and work inside the household. Such a double load and connection to the household limits women's career development opportunities since they have to take into consideration how far from home their workplace is, and how much time they will have for the job if they move upwards in their career while having to take care of the household at the same time. The second option allows women access to wage-earning jobs despite all the obstacles. A growing number of women can now afford to make that choice thanks to development projects that improved standards of living and reduced the load of housework. This improvement in living standard comes with an increase in family living expenses that lead to a change in mentalities and made women's employment a family necessity to meet the required family budget and not an option.

When it comes to the protection of Algerian women from their male dominated society, Human Rights Watch (HRW) still flags some inconsistencies. The 2015 Algerian law on domestic violence successfully criminalizes certain forms of domestic violence after a long wait for such a law. However, "it contains loopholes that allow convictions to be dropped or sentences reduced if victims pardon their perpetrators" (HRW, 2019). In the penal code certain articles about assault and battery can be used to launch a legal action against an abusive husband, however, they can not be a solid ground for divorce under the family code.

In addition, Article 326 of the penal code, which is disputed as a very controversial law among human rights activist in Algeria, gives a person who rapes or abducts a minor the chance to escape prosecution if he accepts to marry his victim. The Algerian penal code does not provide a clear definition of rape but refers to it instead as an attack on honor. 2005 saw some minor amendments to the Family Code that improved women's rights in matters of divorce and child custody. However, the Algerian Family Code still requires women to go to court if they want to request a divorce which remains to be only an option under specified grounds, while in contrast, men's decision to divorce is a unilateral right that does not require any explanation.

Although slow in pace, Algerian women's rights activist fight for equal rights keep bearing fruits. In 2012, after adopting a new regulation of gender quota to increase women's political participation, women made up 31.6% of the Algerian parliament, the highest parliamentary proportion of women lawmakers in the Middle East and North Africa at the time (Ould Ahmed, 2012). They make up about 26% of the current parliament (IPU, 2021).

2 Literature Review

2.1 The Gender Equality Paradox

The increase in women participation in the higher education was a global phenomenon (Clancy and O'Sullivan, 2020). Most of OECD countries achieved most of the progress towards parity between 1971 and 1985. Algeria followed suit with an increase in female higher education enrolment from 21.2% in the 1962/1963 school year to 62.5% of the number of registered Algerian students in 2017/2018. Gender parity has seen a big leap worldwide this century although gender equality is a still a topic of discussion. One of the ways to bring women and men to be equals has been to empower women by improving their access to education. Despite having reached a gender parity in the education sector, many disparities are clearly noticed. Therefore, many of the gender equality issues can be traced back to gender disparities in education.

While the increase in women's access has positively influenced their participation in the labor force, the occupational distribution of women and men has seen no significant change over time (Bradley, 2000). Occupational gender segregation for example, makes women less likely to be found in high paying occupations and more prestigious jobs than men (Bobbitt-Zeher, 2007), which would then translate into significant difference in incomes and career opportunities. Such more paying jobs are found more often in the STEM fields, usually dominated by men in the job market, despite the overall mentioned increase in women's participation in higher education. This increase even reversed traditional male domination in university enrolments towards a substantial female dominating majority (Clancy and O'Sullivan, 2020). These disparities are more noticeable in the fields of Education, Humanities, Social Sciences and Health & Welfare, which are dominated by females even in advanced contemporary societies embracing egalitarian norms such as Norway and Sweden (Clancy and O'Sullivan, 2020, p.351). Similar male and female distribution disparities are noticed in the job market and higher education, where more males enroll in STEM fields. Despite women having better access to higher education in OECD countries for example, it did not trigger any change in the fields they choose to study (Clancy and O'Sullivan, 2020, p.351). Globally, only 35% of STEM students in higher education are women, while only 3% of female students choose information and communication technologies studies at the university level, and about 8% choose engineering, manufacturing, and construction (UNESCO, 2017). This sex

segregation at the higher education level is one of the barriers that make women's attainment difficult. The women's lower presence in STEM subjects at the university level casts its shadow on the job market and copy the same disproportion. To be able to remove such a barrier, these horizontal inequalities at the university level need to be solved before effectively looking at solving the vertical ones at the job market level (UNESCO, 2017).

Based on data from countries that tried to push towards gender equality across the job market, women empowerment through education is not giving the equality results we were hoping for, neither in the labor force nor the public space in general. This gets us to ask the question of whether the assumption that women's education attainment would necessarily allow for an equal participation of men and women in the public spheres. It is worth noting that the choice both men and women make regarding their fields of study could be motivated by the existing employment structures that link certain occupations with a specific gender, and not the opposite, as is often assumed by those advocating for gender equality in the job market through equal gender distribution in higher education. The way women's attainment in higher education is seen to be efficient is only valid if women shift their educational interests towards fields of studies that are considered to be male dominated (Bradley, 2000). So far, in OECD countries for example, this has not been the case, which could reinforce the argument of "gender-essentialist ideology", a theory that considers gender differences natural and a result of the biological differences between males and females, which create rigid gendered roles that are either masculine or feminine (Clancy and O'Sullivan, 2020, p.338). Some would contest the constant comparison of women's development with that of men, arguing that women might have distinctive qualities that set them apart from men (Bradley, 2000). In which case, the pressure to push further than the achieved gender parity in higher education towards an equal gender distribution across the different higher education fields becomes futile as the data do not support such efforts, but it rather shows a constant disparity in gender distribution across fields of study and, consequently, fields of work.

Then why do men and women choose differently? Unless women are not interested in better pay and higher statutes, a rational-choice model should lead women to choose similar fields as men, meaning: law, business, engineering and natural sciences instead of art, humanities, education, or nursing (Bradley, 2000). Educational choices are also affected by social constructs, such as normative assumptions that may associate certain so-called feminine values with certain specific fields (ex, nursing, education), and masculine values with others like

business, mathematics, or engineering, which would lead ‘the educational choices of men and women to reproduce the gender-differentiated patterns of societies” (Bradley, 2000, p. 4). Similarly, social constructs on the nurturing role of women may influence them into choosing higher education majors that lead to caretaking occupations such as nursing and teaching, despite these occupations' lower economic return on investment when compared with jobs often chosen by men (Bradley, 2000).

However, these arguments that try to explain the disparities in gender distribution across higher education, and thus across the job market, do not hold up when compared with certain empirical data. Regarding gender related natural predisposition, despite the dominance of men in the fields of mathematics for example, Stoet and Geary (2018) found, using an international database on adolescents’ achievement in science, mathematics, and reading, that girls have performed at the same level as boys, or better, when it comes to science in two of every three countries. On the other hand, the same data also showed that more girls than boys appeared capable of university level STEM study than had enrolled in most countries (ibid). Regarding the effects of socially constructed social roles and their effect on field choices at the higher education level, Stoet and Geary (2018) found that developing countries seem to have better gender distribution across higher education despite the more rigid gender roles certain societies might have in place. In India, Namita Gupta’s (2019) analysis of the 2015-2016 data of PhD degree recipients in the science and technology faculties show gender distributions closer to parity than in most contemporary societies embracing egalitarian norms. In fact, 44.2% of total doctorates awarded in pure Science in India were awarded to women, while in medicine Indian women made up 42.8% of the total PhD graduates, 36.5% of all PhD graduates were in agriculture and 32% in engineering and technology (ibid). These numbers hold an even higher relevance when compared to the proportion of female researchers in the world. UNESCO’s data shows that only 28% of the world’s researchers are women (UNESCO, 2017). Similar to India, Algeria recorded higher numbers than the world average, with women making up 52.5% of total PhD students, while making up 47% of the 60,000 university teachers. Then what makes these differences so large?

The 2015 Global Gender Gap Index (GGGI), published by The World Economic Forum in its annual Global Gender Gap Report, assesses the degree to which girls and women fall behind boys and men on a selection of 14 key indicators such as earnings, tertiary enrollment ratio, life expectancy, and women’s parliamentary participation. Stoet and Geary (2018) noted that

countries considered largely gender equal experienced some of the largest STEM gaps with regards to gender distribution in both secondary and tertiary education. Using Finland, a country that scores high in gender equality, as an example, we see that Finnish girls perform better than boys in science literacy, and despite the country ranking second on European educational performance, Finland has not been able to tighten the STEM gender gap. In Fact, Finland has one of the world's biggest gaps in gender distribution across the different higher education fields (ibid). Neighboring Norway and Sweden follow suit (ibid). Stoet and Geary (2018) call this the "educational gender equality paradox". They argue that the graduation gap in Stem develops opposite to the direction of the country's gender equality, meaning the more gender equal a country is, the larger the graduation gap in STEM is. However, this gap did not necessarily translate into a dissatisfaction about life outcome. A survey carried by Stoet and Geary (2018), showed relatively positive feedback and high satisfaction from female graduates in countries with larger gaps, such as in Norway. But regarding the reason for these disparities between developed and developing countries (countries with high gender equality and less gender equal countries), they argue that the economic hardship in developing countries pushes students to reconsider one's utility beliefs about what value the pursuit of a career within the STEM fields holds. Especially since these occupations provide a relatively high pay, which is synonymous with economic security, an important thing in countries with low gender equality (ibid).

However, this argument follows the assumption that countries with higher gender equality provide higher welfare, with better levels of social security for its citizens; while the less gender equal countries offer less secure and more challenging living conditions, which would eventually lead to a lower level of life satisfaction among the population. This assumption does not apply to many countries, such as Algeria, where similar welfare conditions are provided for the citizens. This includes free education, free healthcare, free apartments, and much lower living expenses when compared with some developed countries, like Norway. Therefore, economic pressure to pursue educational paths that would provide better income cannot alone be a valid determinant for education choices at the higher education level. With public employment reaching 40% of the total formal employment in 2017 and 20% employed by the central government (IMF, 2018) there are less of an economic incentive to choose certain fields as remuneration in the public sector is based on the degree's level and not the degree's field.

Nevertheless, Richardson et al. (2019) have criticized Stoet and Geary's (2018) usage of the Global Gender Gap Index and the UNESCO tertiary degree statistics, deeming them inappropriate for studying individual predispositions, which should be measured using a psychometrically sound scale of people's perceived or actual gender inequality in relation to their STEM preferences. They propose a different measure alongside the GGGI for analyzing the gender equality in STEM tertiary degrees, the gross completion rates. However, they claim that even these measures would not fully resolve the issue with Stoet and Geary's study as the GGGI does not measure opportunity, STEM encouragement, and empowerment. The GGGI is an index that ranks countries based on the gap in parity between women and men on select indicators, and thus they question its inclusion in correlations without considerations of country-specific parameters and its validation as a measure appropriate for measuring degree of gender equality at the nation level (Hawken & Munck, 2013). The GGGI also does not distinguish between top-performing countries, which is evident in the political-empowerment subindex, which makes no distinction between France and Ireland, which have gender balancing quotas, and Germany and Norway, which do not. Therefore, in the same way that a high GGGI score does not mean that gender equal outcomes are a result of gender equality, a low score does not predict gender unequal outcomes in all domains. Algeria, for example, is ranked second in terms of women's attainment of STEM tertiary degrees. Richardson et al. (2019), attribute this success to societal investment in women's STEM education, distinct cultural beliefs about women's aptitude and affinity for STEM, considerable over-enrollment of women in tertiary-degree programs when compared with men, uneven distribution of men versus women in STEM tertiary degree programs in other Francophone countries, and other factors (Charles & Bradley, 2009; Thébaud & Charles, 2018).

Stoet and Geary (2020) defended their 2018 findings by highlighting the importance of controlling for differences in the overall number of men and women that attend tertiary institutions, which differs from country to country. They also use Algeria as an example to rebuke Richardson et al, by showing that while 53% of Algerian women graduate from STEM, this tell us nothing about the sex difference in the propensity to pursue STEM when 62.7% of Algerian college students are women (Richardson et al., 2020). However, even when they took the absolute number of women graduates out of all STEM graduates yielded a negative correlation between women in STEM and the GGGI (Stoet & Geary, 2018). As for the issue of how an international indicator like GGGI can tell us about sex differences, they note that the index is utilized in the psychological and social sciences and that it is the sole independent

gender-gap index reported annually (Bleidorn et al., 2016; Else-Quest, Hyde, & Linn, 2010). They also note that the gender-equality paradox is consistent with a much broader literature that puts forth evidence of sex differences being larger in more egalitarian countries (Costa et al., 2001).

It seems counter-intuitive for more developed countries to exhibit stronger gender inequality in STEM. An explanation brought forward by recent literature explaining the gender-equality paradox, states that in more developed and egalitarian states, males and females are allowed more freedom and ease in expressing their intrinsically different preferences and interests (Breda et al., 2020). Some theories of social norms consider gender norms as a way for dominant social groups to distinguish themselves from others (Bourdieu, 1979), and evolutionary psychologists believe that social differences can be a means to attain greater cooperation between people by creating subgroups with clear boundaries (Brewer, 1981). These lines of research show how norms regarding behaviors and abilities emerge and maintain themselves. Although they believe that political activism and policy-led changes can eliminate some types of cultural norms, they claim that the norms removed will likely be replaced by other types. In this case, the elimination of the traditional male breadwinner norm does not stop, and can even promote, the appearance of other forms of gender differentiation. This type of research highlights the need to distinguish between two dimensions of gender ideology, male primacy and gender essentialism. The first represents men as hierarchically superior, while the latter represents men and women as fundamentally different but not necessarily unequal. While male primacy has diminished in the past decade in countries where it has been examined, it has been replaced by different varieties of egalitarianism, characterized by diverse mixtures of individualistic and essentialist beliefs, with no country able to eliminate gender essentialism as of yet (Knight & Brinton, 2017).

Based on these theories, an explanation as to why some gender essentialist norms, whether related to math or something else, are more prominent in more equal and wealthy countries, could be that they have developed more independent, individual-focused and progress values that put a lot of value on self-expression and self-realization (Breda et al., 2020). In order to express themselves, citizens of these countries need to make sense of who they are, and in order to do so they will have to fall back on primary identities, which include gender (Ridgeway, 2009; Charles & Bradley, 2009). This may explain how essentialist gender norms are more easily internalized in developed countries, as they provide individuals a cultural background

on which to fall back on when needing to express themselves. Instead of limiting the above phenomenon, the greater gender equality in rights in more individualistic states can in fact reinforce it.

Jouini (2020), contributes to a line of research that relates horizontal educational and occupational segregation to gender essentialism and shows that the gender equality paradox can be explained by differences in culturally constructed gender identities across countries. He focuses on Mathematics, as women's underrepresentation in STEM is greatest in math-related fields like physics, math, computer science and engineering, among others. He highlights three main mechanisms that connect gender norms regarding math with socioeconomic development. First, math plays less of an instrumental value in wealthy countries since their students need less to study in math-related fields to have good job prospects and ensure material security. In such countries, educational and career-related choices probably provide the most opportunity for boys and girls to express their gendered selves (Goldman & Penner, 2016). He argues that, in line with previous sociological research, low economic constrains pushes gender stereotypes to be internalized and affect choices. At the household level, this is shown in the US, where researchers have found that gender essentialist norms are stronger in high-income households than in low-income households.

Second, egalitarian and developed countries usually have greater levels of math performance, which are likely to be associated with a greater degree of internalized gender math stereotypes. Previous research (Mann & DiPrete, 2016; Marakova et al., 2019) has shown that a country's stronger academic performance usually means a more difficult curricula, greater competition and higher performance standards, all of which increase gendered ideas about math and science also had similar findings. Their study on high school students shows that girls and boys tend to view math, physics and science as masculine subjects, with girls viewing them as such more strongly. They also found that female students with a strong masculine image of math and science have decreased odds of choosing STEM majors in university and STEM careers later on. The association of masculine traits with science subjects at school act as a major obstacle for young women's self-identification with the sciences (Nosek et al., 2002; Cundiff et al., 2013), and for their ambitions to become researchers (Šorgo et al., 2018). They also found that a strong association of math with masculine traits had a negative impact on young men's STEM career ambitions. This suggests that boys who opted for majors outside of the STEM field do not fit the masculine stereotype, which means that the strong masculine associations of math

may in fact inhibit both sexes' career choices. They interpreted these findings to mean that among both young men and women, the dissimilarity between how they perceive themselves and the image they have of an academic subject affects them both in their choice of specialization in secondary school (Taconis and Kessels, 2009), and later on in their educational careers.

Third, high-income households spend more time and money on their children, investing in more stereotypical activities, and playing a more active role in their children's educational choices (Williams & Bets, 1990). This might mean that parents in developed countries transmit gender norms regarding educational abilities and decisions to their children earlier, and to a larger extent, than parents in developing countries, leading to higher gender-math stereotypes (Reardon et al., 2019). The theory highlighted above reinforces the idea that gender inequalities across academic fields and occupations will not decrease by themselves as countries become more developed and egalitarian (England, 2020, Goldmann & Penner, 2016). Gender differences in character traits, values and behaviors, such as willingness to compete or risk aversion can also contribute to economic inequalities between men and women and are likely to remain even as countries become more developed.

2.2 The causes of the gender gap in STEM

a/ Skill requirements

As further proof that economic incentive is not the main driver of gender differences in higher education, the majority of member states in the OECD have male misrepresentation in tertiary education across all subjects. Using data from the OECD statistical report, Program for International Student Assessment (PISA), and the World Values Survey, Stoet and Geary (2020), attempted to explain the reasons behind men's underrepresentation in tertiary education. In their study, they theorized that there are three main drivers of disparity between men and women, the first being social attitudes towards women's education, the second, women's reading skills, and third, men's reading skills. Women are at an advantage in reading in all countries where this skill has been measured (Reilly et al., 2019), however, this alone is not enough to explain the disparity between men and women in higher education as it is not something new. They hypothesized that men's underrepresentation is caused not just by their weaker reading, but by society's shift in perspective regarding women's achievements both in education and in society as a whole. They found that they could predict the percentage of men enrolled in tertiary education based on social attitudes and reading competencies with a good

degree of accuracy. In countries where citizens had less discriminatory attitudes towards women's higher education and girls performed better in reading, there were more women than men enrolled in higher education, with the enrolment gap decreasing in nations where boys performed well in reading (Stoet & Geary, 2018). These results could potentially provide a significant explanation for the gender gap, especially since everything, from the art majors to engineering, requires reading fluency and strong comprehension skills in order to be well prepared and successful in all of them, as they all require textbooks and examinations. While men seem to be impeded by their reading skills, women are impeded by discriminatory social attitudes. As a case in point, Mexico has nominally achieved parity in higher education, with 49% of men enrolling.

The model suggested by Stoet and Geary (2020) shows that this equality comes from Mexico having one of the least positive attitudes towards women's enrolment in university, coupled with the fact that Mexican boys do not read as well as Mexican girls. So, what does this mean in relation to female and male enrolment? It seems that, the disadvantages faced by both Mexican boys and girls cancel each other out to produce a seemingly equal gender distribution. This could be the case for Algeria as well, where school enrolment is almost split equally between girls and boys (Tiliouine, 2013). However, Stoet and Geary (2020) themselves admit that, although their model explains a significant portion of the international variance in university enrolment, other factors also play a role, but measuring them is more difficult. One such example is the way the school system is set up, which is more accommodating for girls than boys, as their behaviors and attitudes more closely match those needed by schools to perform and adapt well.

An important thing to note, as well, is the fact that universities in Algeria tend to offer STEM courses in either French or English, however, Algerian students are generally weak in the English language (Mbarki, 2011). Women are also faster and better learners of languages (Heinzmann et al., 2015), and this puts them at a greater advantage than their male counterparts, especially in STEM fields, which require a high level of comprehension. Laufer (1989), found that if a student understands less than 95% of a text's lexis, comprehension of the text will be unsatisfactory. Mbarki (2011) conducted a study on 121 Algerian Microbiology students to find what factors underlined their low reading performance. Her findings echoed that of Laufer (1989), as she found that lexical knowledge accounted for 46.21% of reading performance, with comprehension and coherency constituting the other 53.79%. This may help explain why

female Algerian students are more represented in STEM fields, as they may be able to read, and thus understand the material better than Algerian male students due to inherent differences in the way men and women's brains are wired (Columbia University, n.d.).

b/ Social inequality

Contrary to Stoet and Geary's findings, a study by Breda et al. (2019) found that social inequalities were the biggest drivers of inequality in Math, and ultimately in STEM fields and academic majors. Similarly, to Stoet and Geary, they focused on statistics coming from OECD countries, which showed that all 35 countries had female underrepresentation at high levels of performance, and has been the case since 2000. They found that although girls and boys tend to perform almost equally in Math, among high level performers aged 15, boys outnumbered girls 10 to 7. This is significant because gender gaps among high performers at such an age will affect educational choices and lead to women being underrepresented in math and science, and lead to their consequently worse position in the labor market. Breda et. al (2019) have theorized that men are higher in status in virtually all countries, but that girls' lower status is more likely to damage their performance in countries with less equality and inclusivity. Therefore, the more unequal the country, the more the gender status difference translates into differences in school performance. According to their observations, the ratio of girls to boys in math is negatively correlated with inequality measures like the Gini index, the income Palma ratio, and a measure that incorporates non-economic aspects of inequality such as cultural resources and the parents' level of education. The ratio is positively correlated with poverty rate, intergenerational earnings elasticity and the index of inequality of economic opportunity, among others (Wynarczyk, 2006). Countries that are generally more egalitarian usually reduce several forms of inequality, including the gender gap in math in 15 year-olds. They claim that in such countries, differences in initial status appear less likely to cause differences in performance between girls and boys, and that girls, and students from low socioeconomic backgrounds, are more represented among high performers. They concluded from their analyses that the relationship between the gender performance gap in math and several general measures of inequality is more substantial and hold up more than other, already documented, relationships with economic growth and gender stratification. However, Algeria proves that this theory does not apply to all countries and, despite the country not being a particularly egalitarian state, women are still outnumbering men in STEM fields.

Other theories attempting to explain the gender gap in STEM fields both in university and in the labor market, focus on the perpetual phenomenon of girls and women dropping out at every stage of what researchers have termed the STEM "leaky pipeline". This pipeline begins to leak from school, with choices in school subjects differing between girls and boys, and leaking again during their first degree, and later in higher education, and then of course, in the scientific labor market, where only a fraction of women remain and are able to make successful careers beyond the so-called "glass ceiling" (Greenfield, 1994; 2003; Blickenstaff, 2005). Researchers have identified various barriers that women face, such as discrimination stereotypes, organizational culture, work-life balance and family responsibilities, the lack of female role models, and of course, the very nature of the scientific culture itself. It is evident that the school and home environment have a high influence on girls' perception of their role in society, but it also affects their degree of self-confidence, motivation, assertiveness, experimentation, exploration and risk-taking, all of which are highly important attributes for success in the scientific field. Etzkowitz et al. (2000), claim that boys and girls, from an early age, develop different gendered ideas of scientists and what they do.

Studying graduate computer science and computer engineering students in the USA with the aim of investigating whether women from dissimilar cultural backgrounds have different motivations for graduate studies, Cohoon et. al., found the following. Their examination revealed women from diverse countries are brought to these fields because they are interested in and actually enjoy computing, they are confident in their ability to complete the program and have had positive undergraduate experiences, and they have expectations of a successful career and of equal opportunities with that of men. Watt et. al., examined female teenagers' choices in math participation in high school, seeing as it has implications on their future careers. Based on samples in Sydney, Australia, and Southeastern Michigan, USA, they found that boys tended to select higher levels of mathematics classes than girls in the Australian sample, but not in the US sample. Their findings show that interest in and a liking of mathematics is the strongest influencing factor in the Australian sample, with self-perception of ability playing a bigger role than prior mathematical achievements. Beliefs about ability were also very high influencers in the American sample, affecting girls more than boys.

c/ Pervasiveness of stereotypes

A particularly interesting study by Powell et. al. (2009), shows how women themselves can become propagators of discrimination and put a spoke in other women's wheel, making it more

difficult for them to achieve personal and professional success in STEM fields. They conducted 34 semi-structured face-to-face interviews with female students, and found multiple issues prohibiting the theory of critical mass in engineering. Some being women's acceptance of discrimination, a positive perception of the field, women's critical attitudes towards each other, and women enjoying their novelty status in the field. They found that female engineers either assimilate to the engineering culture, instead of challenging the existent dominant male narrative, or they actually share the perception, values, and attitudes of their male counterparts.

In research and academia, the gender gap seems to be even more wide and discrimination even more blatant. Women faculty members in STEM have lower publication rates than men (McDermott et al., 2018), and they are perceived as less competent by grant reviewers (Magua et al., 2017). This is despite men and women publishing at similar rates and having similar career outcomes, when based on total number of publications (Huang, 2020). Gender differences in career lengths in STEM can explain the gender gap in publishing, as women are more likely to drop out and generally have shorter publishing careers, and this seems to be a worldwide issue spread across STEM disciplines (Salmon, 2015).

This underrepresentation of women in STEM research institutions is frequently attributed to more men than women obtaining advanced degrees (Griffith, 2010). However, the number of women in STEM faculty positions has not increased despite an increasing number of women earning doctorates in STEM (Carrigan, 2011). Another issue in STEM is related to the characteristics valued by departments, which are stereotypically masculine, such as independence and competitiveness. Stereotypically feminine characteristics, such as communality and nurturing, are much less valued, making men more promotable and seen as better suited for leadership roles (Lester, 2008). As a consequence of these stereotypes, women seeking faculty positions in STEM frequently experience discrimination in the hiring process and limited opportunities for advancement, making these jobs less appealing to women, which leads to higher drop-out rates (Kaminski & Geisler, 2012). Furthermore, once they acquire an academic career in STEM, women are two times more likely to leave (Seifert & Umbach, 2008). Women are also more likely to shift academic positions (Valian, 2005; Xu, 2008) and are less likely to be awarded tenure than men despite the fact that STEM faculty members tend to be equally committed to their academic careers regardless of sex. The proof is in the data, with the top 50 research universities in the USA having only 31% of their tenured or tenured-track faculty positions filled by women (Casad et al., 2021).

One of the factors contributing to the unbalanced turnover rate is higher expectations placed on women in STEM faculties. Women are often assigned higher teaching loads and are expected to perform communal roles within their departments more than men (Carrigan et al., 2011). They also feel more obliged to mentor larger numbers of students (Lester, 2008), especially since students perceive women faculty to be more approachable, resulting in more requests, favors and comradeship behavior than their male counterparts (El-Alayli et al., 2018). With the extra tasks and communal responsibilities laid on them, women have less time for their own research, negatively affecting publishing, and reducing their chances of obtaining grants, getting tenure, and moving up the professional ladder.

d/ Lack of social capital

Another major hindrance in the path of women in STEM has to do with social capital. Women STEM faculty generally have less access to powerful social networks and relationships that provide them with essential things like material resources, knowledge of grants and opportunities, and other career-advancing support (Korte & Lin, 2013; Rhoten & Pfirman, 2007). Male faculty, on the other hand, do not struggle in establishing networks with other researchers (Abramo et al., 2013; Collins & Steffen, 2019), they have more knowledge about funding opportunities (Etzkowitz et al., 2000), and are more likely to hold leadership positions (Xu, 2008) and get tenure (Curtis, 2014). According to Korte & Lin (2013), a low social capital affects relationships with coworkers and supervisors negatively, increasing social isolation among women faculty members and decreasing their ability to integrate into STEM fields. Indeed, STEM women faculty have reported a lack of formal mentoring and guidance on achieving tenure, limited ability to network and collaborate, and feelings of isolation and discrimination in their departments (Smith, 2014). This discrimination is evidenced by women having smaller laboratory space, fewer prestigious opportunities and lower salaries than men (Rosser & Lane, 2002; Walters & McNeely, 2010).

e/ Threatening work environment

The STEM academic fields seem to be pervaded by a chilly, unwelcoming and threatening academic environment for women (Casad et al., 2019). These types of environments discourage women from becoming professors and are also influencers of women's high drop-out rates in academia (Riffle et al., 2013). Women report feeling greater ostracism and offensive behavior towards them than their male counterparts (Miner et al., 2019), they also report higher levels of hostility, tension, and disconcertment (Gunter & Stambach, 2005).

Women's perception of their work environment is not simply determined by sexual harassment and gender discrimination (Casad & Bryant, 2016). More subtle cues in their environment and physical spaces can unintentionally communicate messages of exclusion (Cheryan et al., 2009). An example of this would be laboratory and office spaces decorated with stereotypically masculine décor, like predominantly white or male targeted reading materials, and nerdy references to pop culture like Star Wars posters and video game memorabilia. These could communicate a message that underrepresented groups do not belong in STEM, as they might have different interests and décor preferences (Cheryan et al., 2009). Other cues that research institutions and universities might not give importance to their diversity messages communicated on their websites and through employment offers. The language used by institutions has the potential to make a person from an underrepresented feel unwelcome and like they don't belong, and this applies to both current employees and applicants (Ng & Burke, 2005). A negative result of such threatening academic climates is what is called, stereotype threat (Casad et al., 2019). It refers to the risk individuals might feel of confirming negative stereotypes about their racial, gender, ethnic or cultural group. (Schmader et al., 2008). It may lead to various negative consequences for STEM women, including feelings of incompetence, reduced perception of acceptance and leadership aspirations, mental fatigue, and burnout (Hall et al., 2015).

2.3 Possible Solutions to the gender gap in STEM

In order to address the major causes of women's underrepresentation in STEM fields, all stakeholders involved must play their role in implementing a multilayered set of solutions that target the most prominent facets of gender inequality, especially in STEM. The following are seven main areas of focus.

a/ Developing skill and interest.

Longstanding research shows that interest and aptitude are equal determinants of individuals' career choices. For example, girls with high math skills and little interest in STEM fields are far less likely to pursue science degrees than individuals with average math achievement and high interest in scientific subjects (Tai et al. 2006). Therefore, it is imperative to promote both achievement in math and science, and cultivate young women's interest in these subjects in order to generate more female scientists on the long term. Moreover, since women generally prefer careers that involve working with people and making positive contributions to their communities and to society, professions in science and math should be presented as compatible

with these objectives by emphasizing the social and humane aspects of the job (Su et al. 2009). The best time to intervene on this level would be throughout middle childhood and adolescence, before students gain the opportunity of enrolling in advanced science and math classes, which are essential in preparing them for a major in STEM.

b/ Promoting interest in science and math.

Evidence suggests that most individuals make their future career choices before even enrolling in college, and that students' interest in science and math tend to develop as early as middle school (Maltese and Tai 2011) Thus, the earlier the intervention is done, the more effective it will be on the short and long terms. The late childhood to early adolescence period, when children are more able to make domain-specific interest and ability connections to real career options, is especially crucial. Moreover, female scientists report that their school experiences were instrumental in developing their interest and curiosity in science, therefore, ensuring positive classroom experiences for children and young women from elementary through secondary school should be a main focus of stakeholders (Maltese and Tai 2010). Some examples of effective interventions are utilising smaller classrooms for more positive, interactive and individualized interactions between students and teachers (Stecher and Bohrnstedt 2002), creating cooperative learning environments that boost students' confidence in their math skills (Wang 2012), and implementing practical math and science activities that help students relate the material to real-life situations.

c/ Breaking down stereotypes.

An aspect of gender inequality in STEM, which is perhaps more difficult to work on than other aspects, is societal beliefs and pervading gender stereotypes. These stereotypes can negatively influence individuals' beliefs about their strengths and weaknesses even when evidence of their capabilities proves otherwise. They also influence the way individuals behave, think, and feel about their own aptitudes, and the way they perceive others (Wang & Degol, 2017). Thus, there is a need to combat damaging stereotypes by showcasing the achievements of females in STEM fields. Eliminating objects perceived as stereotypically masculine from STEM classrooms and laboratories may also play a role in increasing women's interests in these fields by changing their perception about it not being for women (Cheryan et al. 2009). The media can also play a pivotal role by creating more positive portrayals of professional women in STEM fields through news segments or science shows, so that girls and women see realistic and inspiring images of successful female scientists. Interventions to reduce gender stereotypes and negative

perceptions towards women in STEM must be introduced throughout a person's lifespan, as differential treatment of boys and girls begins early on in childhood and continues throughout adulthood.

d/ Giving importance to effort instead of talent.

A major factor influencing women's underrepresentation in math-intensive fields is the fact that they are less likely to pick occupations that are perceived as requiring innate intelligence and skill, which includes math-intensive fields. In order to counter this, educators should highlight the importance of hard work and effort in achieving success in math-intensive occupations and support a growth mindset in girls so that they understand that math skills are strengthened through effort and persistence (Dweck, 2007). Research shows that praising children's efforts instead of their ability encourages greater achievement and persistence (Mueller & Dweck, 1998). Classrooms that focus on learning and progress over performance seem to be associated with more positive educational outcomes for both girls and boys (Leslie et al. 2015)

e/ Changing STEM teaching methods.

Since girls generally have higher verbal and math skills than boys, they might get more out of math and science lessons if they are taught through storytelling. This strategy might help retain female interest in STEM subjects by capitalizing on their strong verbal skills, and may also increase their interest and involvement in science and math by making these subjects seem more practical and relatable (Kelleher et al. 2007; Sadik 2008). Instead of only relying on dry and highly theoretical textbooks to transmit concepts, formulas and functions, science educators can incorporate novels and writing assignments into their material (Allen 2004). Many scientific achievements and theories have compelling stories regarding their inspiration and development, and exist within a rich historical and cultural context that can give students valuable insights into how scientific ideas begin, progress and influence society. Scientific narratives and hands-on approaches have proven to be effective in increasing interest and engagement in math and science for both girls and boys.

f/ Connecting STEM degree to real life applications.

People in general may not truly understand what STEM degrees really mean and what they allow them to do. Giving youth a comprehensive introduction to the different STEM majors and the careers that they open up for them later on will provide them with a more realistic and

better understanding of the nature of these occupations. Showcasing how STEM majors and careers can be collaborative, innovative, and valuable to society and making STEM occupations more accessible and relatable to female students in their everyday life should increase their interest in pursuing scientific careers (Diekman et al., 2011). It is vital for women to be well informed of the full range of options available to them in STEM, as it will enable the math-competent between them to better evaluate the utility and cost of the various STEM career paths (Stoet & Geary, 2018). Professionals may also want to balance the difficulty of STEM degrees with the degree of creativity, innovation, and enjoyment that they bring. These practices will produce the best results if commenced in late elementary school, when children have more realistic career expectations (Wang & Degol, 2015). Another beneficial approach is engaging students with non-profits or community organizations, providing them with alternative paths through computer science degrees (Margolis & Fisher, 2002). Internships, job shadowing, and other such programs give youth a more hands-on approach to STEM, allow them to truly see STEM professionals and their work environment, and gives them a realistic image as to what a career in STEM could mean for them in the future (Wang & Degol, 2017).

g/ Providing more female role models

Another area of focus should be providing strong female role models, as they have proven to improve women's attitudes towards STEM careers (Cheryan et al. 2011b; Stout et al. 2011). Seeing as they are minorities in STEM fields, women may be disinclined to pursue such careers because of a lack of a supportive network and the sense of connectedness that comes from having female mentors, colleagues and peers. This supports the "leaky pipeline" perception of STEM, and sustains an unending cycle in which women are not recruited due to the initial problem that there are note enough women to offer support in STEM fields. However, wider exposure to successful female role models might encourage girls to retain their interest in science and to reject the stereotype that careers in math and science are for men. Career fairs coupled with talks and visits by successful female STEM professionals and scientists can be highly beneficial in this regard (Wang & Degol, 2017). On the university level, STEM departments should take a proactive approach by providing and encouraging female-friendly networking opportunities. Ideally, in order for this approach to truly have long term success, girls should be introduced to STEM role models in elementary school, for them to start associating "girls" with "science" and "math" as early as possible.

h/ Accommodating women's obligations at work

In academic as well as non-academic careers, women's professional responsibilities conflict with their familial obligations. Workplaces often do not provide the adequate support for women with young children and other caregiving responsibilities (Cesi & Barnett, 2009). This results in women deciding against pursuing STEM careers and also vacating STEM positions at higher rates than men, especially after taking maternity leave following the birth of a child. This in turn leads to a decline in the number of women at the top positions in their fields. Practical solutions to this problem include instituting on-site high-quality childcare for female graduate students, faculty members, and professionals, providing paid maternity leave and stopping tenure clocks for maternity leave (Wang & Degol, 2017). Although these solutions mainly target women, similar opportunities and benefits should be provided for fathers, so that they can better support and be readily available for their spouse and children.

2.4 Recommendations for Future Research

a/ Tackling the gender gap difference within STEM fields

Extensive research has been dedicated to studying gender differences between non-STEM and math-intensive STEM careers, but not many studies have focused on the gender gap within STEM occupations or have investigated why females are more drawn to less math-intensive professions. The extent of women's underrepresentation in STEM varies by domain, while women now account for almost half of medical doctor degrees and 44% of PhD degrees in the life sciences, they continue to be most underrepresented in the most math-intensive STEM fields. It can prove beneficial to examine the factors that influence women's choice of entering math-intensive occupations versus less math-intensive ones (Wang & Degol, 2017). For example, are females with equally high verbal and math ability more likely to pursue careers in medical fields than in engineering? Do gender differences remain due to women equating less math-intensive STEM careers with achieving societal goals and more math-intensive STEM careers with achieving more personal goals? Differentiating between the factors that lead women to choose specific STEM disciplines, especially those with the lowest female participation, may give us deeper insight into the way girls and women perceive the different STEM fields, and the motivations behind their choices.

b/ Targeting female racial minorities

Many researchers have been focusing on closing the gender gap in STEM, however the racial gap within even the female segments is often overlooked. Latina and African American women are more underrepresented in STEM fields relative to their White and Asian counterparts (Kena et al., 2015). Women tend to be seen as a homogeneous group of people with the same needs, experiences, and obstacles to social progress. Consequently, many studies treat gender and race separately, which does not allow us to see how the intersection between the two affects female representation, and pushes us to overlook possible explanations to this phenomenon that can be found within the context of racial minorities' sociocultural history. African American and Latina women are also more likely to face additive discrimination; this is especially the case in STEM fields, where academic stereotypes around both gender and race are pronounced. Seeing as female racial minorities face unique challenges and require tailored protective measures in STEM fields, future research should study the interconnected roles that race and gender play in the misrepresentation of female racial minorities in STEM and policies should be shaped to address the unique needs of this segment of the population (Kena et al., 2015).

c/ Investigating the role of math, science, and English

Little is known about the relative impact of English, science, and math interest and ability on youth's educational and occupational choices in STEM. The method of either combining science and math into one general factor or studying the two in independent models restricts our ability to compare their influence. If we do not study them jointly, it will be difficult to know whether high science and math interest influence STEM choices equally or if high interest in one domain can balance out low interest in another (Wang & Degol, 2017). Further research is required to study the interrelationship between domain-specific ability and factors influencing motivation.

d/ Examining the relationship between psychological, environmental, and biological factors

There has been extensive research on biological, psychological, and environmental factors influencing female career choices and STEM performance, however, not enough studies have incorporated the three into their research model and examined the complex interplay between them. Although research has focused mainly on identifying the sociocultural and biological factors responsible for the difference in gender abilities, career choices and interests, separating psychological and environmental influences from genetic heredity is proving difficult (Wang

& Degol 2015). It is evident that these factors play a synergistic role in the gender gap problem in STEM, coming together and interacting over time, therefore, researchers must utilize integrated models to explain the tangled interactions between sociocultural, psychological, and biological factors, and how they affect the performance of females as well as males (Wang & Degol 2014b).

e/ Moving into evidence-based interventions

There is a need to translate research findings into effective practices (Liben & Coyle 2014). Several interventions have proven successful in altering both girls' and women's' perceptions of STEM fields (Stake & Nickens, 2005; Weisgram & Bigler, 2007). There are still many unanswered questions concerning the most effective implementation of gender-balancing interventions, such as, what is the best delivery method for these programs? How long should the effects of promoting female interest in STEM early on last for the intervention to be considered successful? Future studies should examine longitudinal changes and whether they are effective in producing meaningful change in women's professional interests and goals. Moreover, interventions should not only concentrate on changing women's attitudes towards STEM, they must also be directed towards parents, educators, STEM faculty and employers to tackle the implicit and explicit biases and stereotypes individuals have against women in science. More exhaustive evaluations of STEM interventions through the use of comparison groups, long-term follow-ups, and examinations of the unintended ramifications of such programs are vital for closing the gap between research and practice.

f/ Employing a gendered perspective

Some researchers believe that looking at inequality in STEM from a sociological lens that identifies gender as a social structure may provide us with a clearer idea of the factors that come into play. Critical gender theorists suggest that gender consists of a multitiered and connected system consisting of the macro level, including politics, culture and economics, the micro level, including personal exchanges, and the individual level, which involves internalized values and beliefs (Eisenhart & Finkel, 1998; England, 2010; Risman, 2004). Therefore, some researchers believe that we should further study how STEM domains fit within the larger gender inequality structure instead of focusing on them separately. Charles and Bradley (2002) argue that Western culture still endorses the idea that genders are intrinsically and profoundly "equal but different", therefore encouraging individuals to perform distinct behaviors that are deemed appropriately feminine or masculine. Our institutional and cultural

logics promote the maintenance of gender essentialist beliefs, pointing out that a sizeable part of women's progress in the academic and occupational sectors is in fields that adhere to traditional gender roles, and that even when they enter "masculine" fields, women tend to choose subfields that seem consistent with their gendered notions of their interests and "true selves". Therefore, even though girls' performance in math and science may improve in secondary school and lead to higher enrollment in advanced courses, these are usually performed because such actions are important for college admission (Adelman, 1999). However, because the pervasiveness of gender essentialist beliefs in society and the associated socialization and interactions that support them, gendered choices of major will not necessarily change as well.

2.5 Conclusion

There seems to be four major perspectives on the issue of gender misrepresentation in STEM. The first perspective focuses on individual abilities, such as reading and spatial skills and performance at school, the second one emphasizes the social dimensions influencing decision-making and behaviors both in STEM and in the general society, the third perspective studies the workplace environment, and finally, the fourth perspective examines how women's self-image and internalized beliefs affect their career choices. Studying one aspect by itself cannot provide a comprehensive understanding of the causes of the gender gap in STEM, as such phenomena are ultimately the result of an interplay between many factors, such as biology, psychology, sociology, culture, and history. Solutions to decrease this gap must start at a young age and focus on all facets of a person's life, making sure the societal, psychological, economic, and biological factors that come into play are well considered and targeted. In order to implement impactful interventions that lead to sustainable and true change, more research needs to be conducted on the interplay between the different factors influencing the gender gap in STEM, and there should be more relevant interventions targeting racial minorities, seeing as they face the greatest discrimination.

In the process of investigating the reasons behind the gender equality within the STEM education in the Algerian higher education, we looked into how the participants in this study relate and perceive these four perspectives detailed throughout the literature review, with a focus on the social dimensions and women's internalized beliefs and self-image.

3 Theoretical Framework

The research starts from Stoet and Geary (2018) research about the gender equality paradox in STEM education which explain the drop in gender-equality in the STEM fields in gender-equal societies. They suggest that a pressure related to life-quality in countries considered less gender-equal pushes girls and women to get more involved in STEM subjects in their look for better financially rewarding occupations (Stoet & Geary, 2018). As seen in the literature review, Stoet and Geary's research created a large debate around the appropriateness of the used sources, and although that debate remains unsettled, their gender equality paradox in STEM remains worth exploring. This research's aim is to look into what previous studies have identified as causes for this education gender equality paradox across the developed countries where the paradox persists and against that backdrop explore the situation in Algeria, a developing country where the education gender equality paradox does not exist. This research is mostly qualitative in nature as it uses interviews and surveys to investigate the established research questions.

4 Methodology

The aim of this chapter is to introduce the research methodology for this qualitative based study around what motivates Algerian women to choose a specialization with STEM for their university studies, in the hope to negate or confirm Stoet and Geary assumptions in this regard. This approach allowed for a deeper understanding of Algerian students' perception of the STEM fields and how that perception shapes their choice of one field over the other. It also allowed us to have a glimpse into the way Algerian students, males and females, perceive their future work environment after graduating from a STEM specialisation, and how that could make a difference in the major they choose to study in the first place. This study, given the methodology chosen, enabled finding that can feed into theory.

4.1 Qualitative Research Approach

The choice of a qualitative methodology for this research proves useful in discovering the meaning that the participants in the study give to the different events they experience (Merriam, 1998). This Study uses qualitative interviews to get to people's perceptions and experiences to

comprehend how they see, experience, and make meaning of the subject of the study, such as the effects of the gender roles perception on the choice of a major at the university level, in a way that is similar to the phenomenology method. The phenomenology method has proven to be particularly effective in the study of smaller numbers of participants (five in depth interviews in this study) to outline the shared aspects of their experiences with the phenomenon subject of the study (Creswell, 2003) and to come out of this study with patterns and meanings that will be the basis for new knowledge (Moustakes, 1994). The used qualitative research methods are described in more details later in this chapter and are included in the used survey, sampling methodology, and open-ended interviewing. The grounded theory and constant comparative method (Glaser and Strauss, 1967) were used to discover the meanings behind the data collected through the surveys and the interviews.

4.2 Participants

For the sake of collecting primary data for this study, 51 Algerian university students answered an internet survey with multiple choice and open-ended questions about the process they went through to choose the majors they are studying. The participants in this first stage of the study, consisting of an online survey, were chosen based on a judgmental, or a purposive, sampling method. “This sampling design is based on the judgement of the researcher as to who will provide the best information to succeed for the objectives study” (Etikan and Bala, 2017, p. 215). It is a non-probability sampling technique. Participants are selected based on their experience, knowledge, and their relationships in regard to the subject of the study. All participants were Algerian STEM students from different universities in Algeria. Participants in the survey were all fulltime students and unemployed. 51 participants from for different universities, and from different regions in the country took place in the study, allowing for a fair representation of the different cultural backgrounds and university environments in Algeria, since smaller cities might be more conservative than bigger ones.

In a later stage, five participants were chosen among the 51 for the second part of the study, the in depth interviews. These five participants were female STEM students who faced resistance from their entourage when choosing their present STEM majors but still pursued studies in these fields. They were chosen as participants as they would make good “knowledgeable informants” able to provide insights and answers to the different research questions (Lincoln & Guba, 1985, p. 234). Since the aim of the study was to understand the reasons behind the gender equality in STEM majors in Algerian universities, it was important

to include both males and females in the surveys to see if there are any differences or similarities in the way male and female Algerian students perceive gender roles. The focus in the in-depth interviews, however, was on female Algerian students as they are the one making the difference by choosing more STEM fields in a male dominated society, especially when compared to what is observed in more gender equal societies like the Nordic countries. The aim here is to understand the motivations and logic behind such choices in Algeria.

The five participants in the interviews, all females, were from different region in Algeria, attending three different universities across the country: University Hasiba Ben Bouali in Chlef, the Houari Boumedien University of Science and technology in Algiers, and University of Science and Technology Mohamed Boudiaf in Oran. As smaller cities and universities tend to be more conservative than bigger ones, this diversity was needed to have a more diverse set of opinions and experiences. However, the results, as we will see later in the data analysis, showed that the size of university or city had very little effect on the kind experience female students go through when choosing their major right after high school.

4.3 Role of the Researcher In qualitative research

The researcher in any study is considered a primary instrument of research. What he/she may bring into the research from his/her own background must be considered a bias and treated as such (Maxwell, 2005). Because qualitative research is an interpretative one, biases can interfere with the analysis of the collected data of the with the data collection itself (Strauss & Corbin, 1998). This could be put under some control through a full disclosure (Altheide & Johnson, 1994). Therefore, I acknowledged that my personal cultural background as an Algerian educated male could influence my interpretation of the collected data. My previous study and work in the STEM field might have influenced that my judgment that this field might not be the most welcoming to female students and workers. To reduce the effects of personal bias to a minimum, member checks were used within the interviews to improve the study's validity, credibility, transferability and trustworthiness (Lincoln and Guba, 1985). Information collected during the interviews were summarized and restated, checking their accuracy with the interviewees. The interviews were transcribed and sent to each participant for review for accuracy. Three of the five participants returned the transcripts unchanged, while two add more details to their answers, these details were not mentioned during the actual interviews.

The researcher in this study worked in engineering for four years and in journalism for eight years. He holds a bachelor's degree in Mechanical Engineering, a bachelor's degree in International Business and Trade, and is in his second years a Master of Science in International Relation in addition to the Master of Science in Global development and Planning for which this study has been conducted. None of the participant had a direct relationship with the researcher in any way that might have represented a conflict of interest or imparted bias on the study.

4.4 Surveys

The survey for this study was conducted online using google sheets. It had a mix of quantitative questions with multiple choice questions, checkboxes, and net promoter scores; and qualitative question asking then participants to elaborate further based on their previous answers in the quantitative part in an open-ended manner that gave them space to explain their answers with more details behind their reasoning. Unlike the quantitative questions, responses to qualitative questions present a greater challenge at the data analyses stage. Because they cannot be quantified, analysing qualitative data requires identifying recurring trends and patterns.

Multiple choice questions were presented to the participants followed by open ended questions asking to explain their choices in order increase the likelihood of honest answers. Questions regarding certain topics were asked in different forms to insure credibility and honesty of the respondents. For example, when investigating Algerian students' perception of gender roles in connection with the major they are studying, they were asked to choose who is more suitable for their field of study: boys, girls, or both, followed by an open-ended question asking them to further explain their choice. Further in the survey, they were asked to rate the suitability of each gender for their field of study. This provides different data points to investigate how the participants perceive gender roles in relation to their field of study and allows to verify the participants' coherence.

These are the profiles of the five students participating in in the interviews stage of the study. Their names were changed to protect their privacy:

Nadia: 19 years old. A 2nd year student of civil engineering at the university of Hassiba Ben Bouali in Chlef after a first year in Science and Technology general studies. Nadia is from Chlef.

Namira: 19 years old. A 2nd year student of Information Technology at the university of Hassiba Ben Bouali in Chlef. Like Nadia, she spent her first year as a student of Information Technology and Mathematics general studies year. She is from the town of Ain Defla, 72km East of Chlef.

Noura: 26 years old. In her first year of PhD studies in Mechanical Engineering at the Houari Boumediene University in Bab Zouar, Algiers. She is from the capital Algiers. She studied Mechanical engineering at the University of M'hamed Bouguera in Boumerdess, where she also did her masters before she successfully starts a PhD in Mechanical Engineering in the Houari Boumediene University of Science and Technology.

Nour: 20 years old. A 3rd year Civil Engineering student at the University of Science and Technology Houari Boumediene in Algiers. Nour is from Algiers, and she spent her first year as a Science and Technology general studies student.

Nejma: 20 years old. 2nd year Information and Technology student at the University of Mohamed Boudiaf in Oran, 414km west of the capital. She studies Information Technology and Mathematics in her first year of University. Nejma is from Oran.

4.5 Interviews

The choice of qualitative interviewing is the most appropriate when "studying people's understanding of the meaning in their lived world" (Kvale, 1996, p.105). It is a technique that allows researchers to discover the intangible things we cannot observe directly, such as thoughts, feelings, or intentions (Merriam, 1998). Qualitative interviews produce a thick descriptions of the study subject (Rubin and Rubin, 1995), allowing us to secure information collected from different sources (Lincoln and Guba, 1985). In this study, all five interviews were conducted over the internet through a Zoom call due to the restrictions forced upon face-to-face interactions by the COVID-19 situation. The Zoom calls were an efficient way to conduct interviews as they became the main method of communication for students around the world as they moved to online based learning, making it possible to accommodate students with busy schedules. Furthermore, Zoom calls were a practical way to connect with the participants in this study as they all resided in different part of Algeria, while the researcher resided abroad. As for the process according to which the interviews were conducted, first, the purpose of the study was explained to participants as well as the research procedures, the protection of the participant's confidentiality, and their right to withdraw from the study at any

time. After receiving participants approval, the interviews were recorded to get a complete transcript later on (Merriam, 1998). A semi-structured interview method was used, giving participants room to answer based on what they considered more important for them to highlight and talk about (Miles & Huberman, 1994). However, interviews were more structured towards the end when conducting member checking (Lincoln & Guba, 1985).

The interviews main questions were presented in Algerian Arabic dialect, without restricting the participant to one language. The participants used a mix of Algerian Arabic dialect and French or English in their answers. The follow up questions were asked in one of these languages, depending on the language used in the participant's answers at that time. The interview started with, "Please describe how did you end up choosing the major you are studying now". The question was asked in this way to allow the participant a flexibility and freedom of exploring in depth the phenomenon subject of the study (Strauss and Corbin, 1998). Open-ended questions were used in the interview to allow participants to answer freely and talk openly to queries (Kvale, 1996). Sometimes probing questions were asked when judged important to clarify an answer (Rubin & Rubin, 1995). Participants were often asked "why", or "Can you tell me more?", to encourage them to elaborate more and as a way to dive deeper in the meaning of the participants' answers in order to get a better understanding of their experiences. The main interview questions were mostly asked exactly as they were planned and written:

1/ "Please describe how did you end up choosing the major you are studying now."

2/ "What were the advantages of this major that might have encouraged you to choose this major."

3/ "How do you think your entourage affected your choice study field at the university level?"

4/ "Please describe your experience as a female student in your university as compared to a male student"?

5/ "How do you imagine your future career and what kind of challenges do you expect?"

4.6 Data Collection

Memos were taken during and after each interview to note down research thoughts and highlight certain comments. Each interview was recorded electronically using the offline

recording machine Zoom H4n Audio Recorder. Each interview started with an open-ended question about the participants' experience choosing a STEM major right after graduating high school. All interviews were conducted after confirming the informed consent of the participants. Each interview was conducted in one single session. All interviews were transcribed afterwards.

5 Data Analysis and discussion

Analysis happened through three phases. First, data collected through the survey was reviewed in search for recuring patterns, especially in the participants' answers to the semi-structured questionnaire part. This allowed for thematic analysis based on three main themes that stand as follows:

1/ Considerations when choosing a major are not mainly economic

2/ Little influence from the family

3/ Students' self-awareness, awareness about the economy and society

The initial conclusions derived from these results shaped the semi-structured interviews that followed up later on with five of these participants. The survey highlighted the corners of this study that needed further investigation and explaining. Interview notes and transcripts were reviewed in search for recurring patterns and "regularities" (Merriam, 1998, p.180).

5.1 Limitations

The survey was built to be used in face-to-face data collection in Algeria. However, the COVID-19 situation led to opting for an internet-based survey for health safety reasons. It is also important then to note that he results of this study are limited by the way the participants interpreted the questions in the survey, but also in the interviews. Although the number of respondents to the survey was acceptable (51), the number of participants in the interview (five) was small. A larger pool of interviewees could have produced different, or highlighted additional, findings.

5.2 Pilot Study

It is recommended before the start of the actual study to conduct a pilot study to help set and develop the relevant lines of questions (Yin, 2009). For that purpose, discussions with five female STEM students were held around the findings of Stoet and Geary (2018), their thought process when picking a major after graduating from high school, and their experience with study environment at Algerian universities. This process helped in determining the exact research questions of this study, as well as the main lines of the distributed survey and conducted interviews.

5.3 Results

The data collected from the surveys confirmed the assumptions of this research early on, while the interviews helped shape the logic behind these results and the thought process and the intentions of female students behind their choice to study a major within the STEM fields. In this section we will be presenting the findings of this study. These findings were organised along the following thematic areas:

1/ When choosing a field of study, most female Algerian students have other considerations than the economic benefits of getting a degree in STEM.

2/ Algerian female students' choice of field of study is mainly influenced by their results in baccalaureate and seems rarely influenced by peer pressure.

3/ The way high school studies are divided into either science, technology, or social science and humanities encourages students to stay within the field they chose in high school once they reach university. On the other hand, there is a possibility to study a general science and technology major in the first year of university, for those with a low baccalaureate results, with an option to choose a specialisation in the second year. Such an option encourages student to continue in a STEM field, giving them a second chance of re-orientation after their first year of general university studies.

Theme 1: Considerations when choosing a major are not mainly economic.

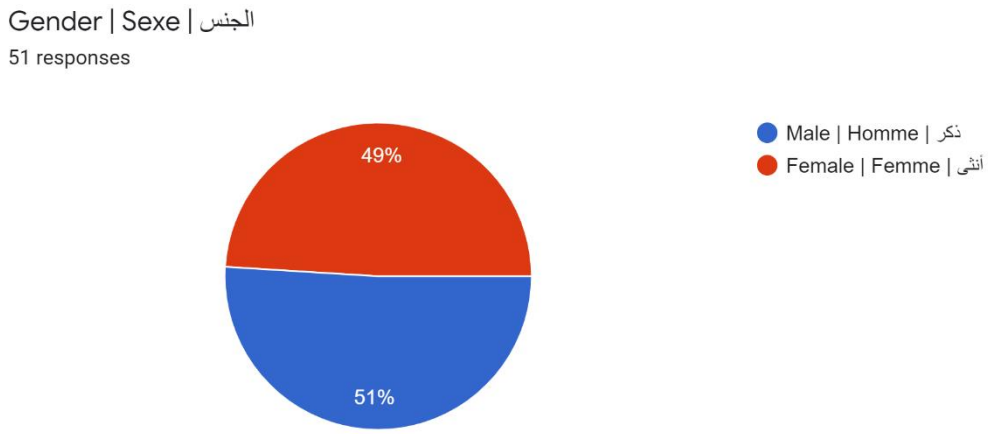

Chart 1

As we see in chart 1, the total number of participants in the survey is 51 participants, among which 25 were females (49%) and 26 were males (51%). One of the respondents mistakenly answered "no" to the question "Did you/Will you study a science, technology, engineering, or mathematics specialization?", despite having studied Geology (a STEM field), and therefore his entry was considered relevant. All other entries that did not fit the set profile of participants were removed from the data analysis. This includes one high school students and three students of humanities or social sciences.

Although the study was meant to investigate the Algerian female STEM students and their thought process when choosing a major to study at university, male STEM students were included in the study for the following reasons:

1- To compare if the thought process and reasoning among female Algerian STEM students is gender specific or a general though process shared by both genders and all students can relate to.

2- To compare how male and Female students sees each gender suitability to study a STEM major, and how the existence, or absence, of such a judgment affect in anyway their choices.

3- To verify if any differences exist in the motivations put forward by each gender for choosing a STEM field as a major in university, especially the economic considerations Stoet and Geary argued for.

Chosen Major	Total number of participants	Female Participants	Male participants
Information Technology	17	10	7
Civil Engineering	17	7	10
Mechanical engineering	3	1	2
Science and Technology	2		2
Fluid Mechanics	2	1	1
Biology	2	2	
Electromechanics	2		2
Physics	1		1
Operations research	1	1	
Electronics	1	1	
Geology	1	1	
Materials Science	2	1	1
Total	51	25	26

Table 1

Table 1 shows the distribution of participants across the different majors. The majority of respondents in the survey (34) studied either IT or Civil Engineering. Access to these majors, if not admitted to one of the highly sought after “Ecoles Superieurs”, is only available in the second year of university after a first year of general studies in Math and Information Sciences that allows access to the Information Technology specialisation in the second year, or a first year of general studies in Science and Technology that allows access to the Civil Engineering specialisation in the following year. Math and Information Sciences general studies year also

allows students the option to study mathematics as a major in the second year, while the Science and Technology general studies year allows students to choose among a larger poll of specialisations: Electronics Engineering, Biomedical Engineering, Telecommunications, Automatization, Electrical Engineering, Mechanical Engineering, Aeronautics, Climatic Engineering, and Civil Engineering. Depending on the university, all or only some of these specialisations might be available. Access to these specialisations is based on the students' choice, their ranking in the first year of study, and the capacity of each of the faculties. Access to the first year of each of the two general studies options is possible with an average grade as low as 10/20 in the baccalaureate (the minimum needed to graduate high school), which gives students a chance to redeem themselves in some sort and work harder to perform better in their first year of university in order to improve their chances of getting admitted to their favourite major in the second year. Direct access to a major in IT at the prestigious Ecole Superieure d'Informatique in Algiers, for example, requires a minimum average grade of 14/20 in the baccalaureate according to the 2020 admission requirements, and student from all over the country compete to get into this school, unlike universities for which the competition is mostly regional.

The general studies year system also allows young students to take the time to figure out what they exactly want to study. According to the survey data, the majority spends their high school years undecisive about what they want to study after the baccalaureate. The data shows that many of the survey respondents (39.2%) receive no assistance when deciding about a major to study, while 23.5% get the help they need from the internet. Among the survey respondents, several people indicated that they chose one of the two general studies specialisations because it was suggested by the system, while in the interviews some participants talked more about an uncertainty about what major they wanted right after high school. Nadia, who is in her second year of Civil Engineering said:

> "Up until the day I had to choose a major, I was not sure what I wanted to study. I had no idea. Nothing really prepares you for this. Everyone tells you to pick what you really like, but I did not know what I really liked. I knew what I was good at. I was good in math and physics, and really bad in chemistry. I actually hated chemistry, so I knew I did not want to study anything chemistry related. Even if I had 17/20 in the baccalaureate, I would not have chosen medicine or pharmacy, everyone seems to want to study those two. I would have probably picked architecture as my first option. I

thought if I stick to engineering, I can make use of my drawing skills, but I discovered now on my second year that none really draws plans by hand anymore, it is all computer based, not like what we used to do in high school."

When asked if she considers her choice of civil engineering a random or conscious choice, Nadia explained that she had more time in university to think about her future:

> "In high school all any one really cares about is getting the baccalaureate, whatever comes after seems less important and none really prepares for it. This changes in your first year of general studies at university. From day one you know that this year is to prepare you for the second year when you will have to pick something that will stick with you for the rest of your life. So you spend the first year accordingly. This becomes the source of discussion between friends and with professors. Luckily, a year is enough time to look into all the options available here at the university. I considered them all, and civil engineering seemed to be the most interesting. But still some students would be happy with whatever option they are given in the second year".

Najma, who is in her second year studying IT, on the other hand mentioned a lack of options:

> "With a 12/20 baccalaureate, you do not have the luxury to choose. My options were to either study something easy and with a low demand like archaeology or environment protection or choose a general studies year and work hard to study something worth spending the time to study. Everyone seemed to be picking the second option. I picked it not knowing what options it had in the second year. I just knew that my cousin did it and is now studying IT. I thought that IT is still better than archaeology. Plus, I would not live away from home to study archaeology."

When asked why she thinks IT it is better than archaeology, she said:

> "I do not think anyone choses to study archaeology, it does not leave you with many options after graduation. You would have to work in a museum or something of the sort. I can not think of myself working in a museum. I can not think of many places they would need a degree in archaeology. It is not the kind of major where you would need to be smart. You just need to memorize whatever they give you. I think people who end up studying do not really choose it. They probably have not qualified for anything else. If I wanted to study something like this, I would not have put so much

effort in high school to study math and physics. I spent a lot of money on private classes as well. I would have opted for an easier high school life and would have studied literature for example, would choose law or archaeology in university."

"Maybe I should have done that", She added jokingly.

As part of the university orientation, the automated system the students have access to, to login the 10 choices after graduating high school, filters out the majors and specializations a candidate has access to by taking into consideration their field of study in high school, their average grade in the baccalaureate, and the minimum average grade required for each major. This minimum average grade does not guarantee a student's successful selection for a major since the lowest average allowed into the major changes yearly since priority is given to those with the highest averages until saturation is reached. The baccalaureate holder organises the 10 majors he picked from 1st to 10th based on personal preference and he/she would be admitted to the first option that satisfies all the mentioned criteria. If none of the student's 10 choices satisfies the admission criteria, the system gets admitted to a major chosen by the system based on those same criteria. After the decision is made, it is final. It is rare for a student to be allowed to change majors or universities. Due to the way the Algerian university orientation system is set up, a student of the Technology specialization in high school would not have access to all History and Geography related majors for examples, but instead majors within the fields of engineering would be more suitable, but getting a low average grade in the baccalaureate limits further the list of choices, prompting candidates to pick general studies in the hope to improve their options in the future and get access to majors they do not have access to right after graduating from high school. This way, if a student was aiming to work in the pharmaceutical field but did not have the minimum average grade to choose pharmacy among the 10 choices, they can opt for a general studies year in Science and Technology and choose Biomedical Engineering in the second year or study a year of general studies in Life Sciences and choose Biology in the second year. Furthermore, each of the second year of university specialisations offer more specialisations at the master's studies level.

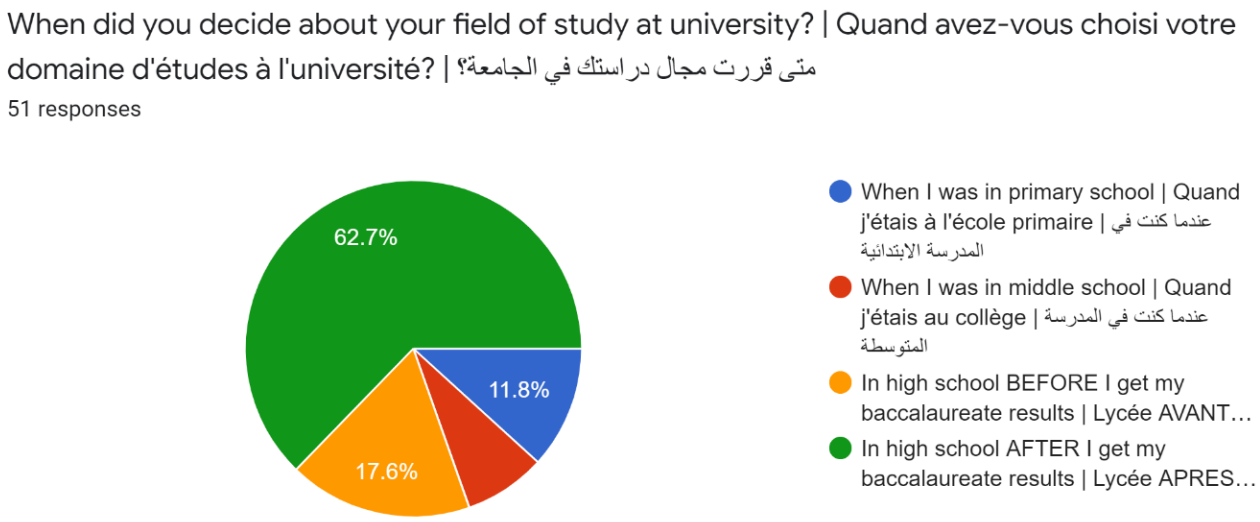

Chart 3

This lack of direction and orientation manifests also when looking at when do Algerian high school students pick their university majors. As shown by the survey results in Chart 3, the majority of students (62.7%) wait to get their baccalaureate results before they decide what major to pick, while 17.6% decide about what to study in university during their high school years but before the baccalaureate results are out. The reason could be that the student's high school results could be an indicator of their performance in the baccalaureate, therefore the student can estimate the majors they can, or cannot, have access to based on those early results and last year's minimum averages required to access the different majors. Lastly, 19.6% decided about the major they want to study before high school.

Also going in the same direction, when asked about the reason they picked the major they are studying at university (Chart 4), the majority of the students participating in the survey (45.1%) answered that it was due to their baccalaureate results. 33.3% of the participants said that their choice was based on the availability of jobs in the field they are choosing, 21.6% said it was their childhood dream, while only 17.6% mentioned the high income as a reason for picking a certain major in university. It is worth noting that participants in the survey had the possibility to choose more than one reason. These results show that the economic factor, and higher salaries available in the STEM fields, as argued by Stoet and Geary (2018), are not the main

concerns of Algerian students when choosing a major to study in university. These results are similar among both male and female students.

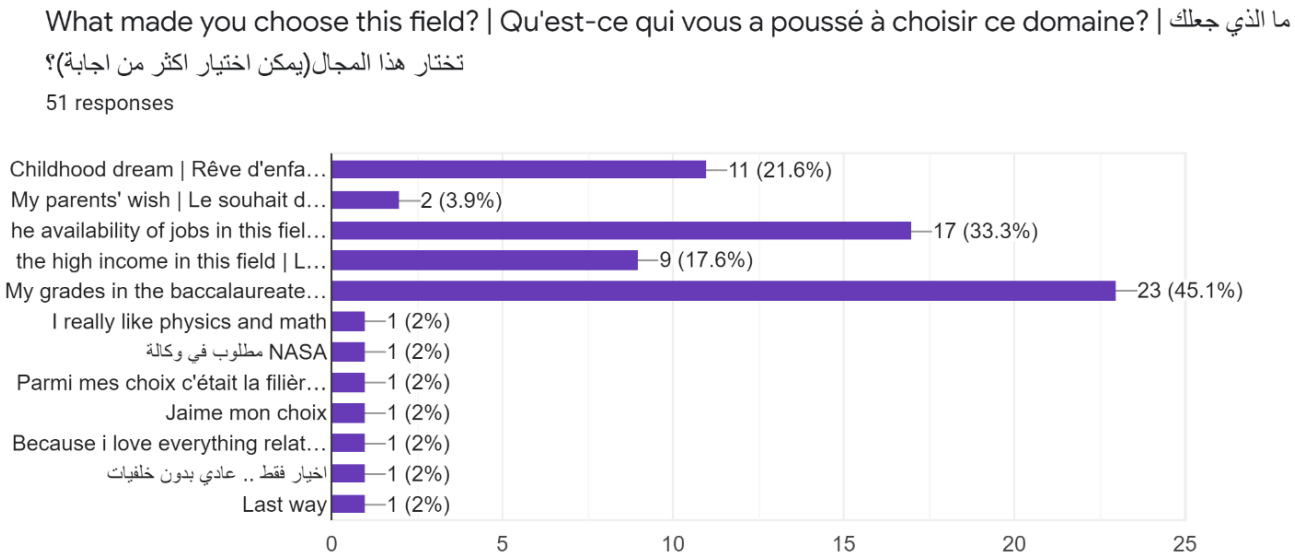

Chart 4

The interview data comes in to further confirm the above survey data analysis. As seen in previous statements from the interviews, there is a constant reference to the grades obtained in the Baccalaureate. Three of the five participants in the interviews said to have chosen their majors because their average grade in the baccalaureate was not enough to choose anything else they thought was worth studying. Like Nadia, Noura, (26), who is now on her first year of doctoral studies in Mechanical Engineering, said to have chosen Science and Technology as a major, but she was not sure what she would study in the second year yet:

> "I never thought I would study mechanics. All my friends ended up studying science and technology. It was my 7th choice in the list. I knew with 13.82/20 in baccalaureate there is very little chance of getting any of the first six choices, but still, I chose them. You never know. So, I put the University of Boumerdes as a guaranteed choice, otherwise the system would have chosen for me if I were not fit for any of my 10

choices. It is only in the second year that I decided to continue in mechanics because, mainly because I had good grades in all mechanics related subjects."

Namira had chosen Medicine, Pharmacy, and IT at the top 3 of her options, and to that she said:

"I made sure to pick the best choices first, then everything else."

Nour, on the other hand, knew what she wanted to study but took her final decision after getting the baccalaureate results.

> "The Ecole National de Travaux Public (National School of Public Works) is barely 10 minutes away from where I live. I pass by there almost daily. I always thought that I might study there one day, but I never had serious thoughts about until the year of my baccalaureate. I studied hard but I knew my baccalaureate results were not enough. So I ended up choosing another path that leads to a similar degree but in a university instead. I ended up changing my mind and chose civil engineering instead of public works in the second year, but they are mostly the same. I just realized that I prefer buildings to roads and bridges. Luckily, most students usually get what they chose in the second year".

Namira, who is an IT student in the University of Chlef, faced a bit more resistance from some family members compared to the other participants:

> "My mother advised me to study law, but anyone can study law", she said.

When asked why it is bad that everyone can study law, here answer was that there are too many law students because access to this major is easy with any high school specialisation and an average grade of 10/20.

> "I worked hard to get an average grade of 12.75/20, although that is still not enough to get into anything prestigious.", she added.

When asked why not choose to study a Social Science major since these majors have a lower entry conditions then medicine or engineering, Namira's answered was connected to her skills:

> "I worked hard to be good in math and physics and I do not want that to go to waste. If I can use that in my university studies, then why choose a major where I would have to start from zero. I prefer to stick to what I am good at."

Namira's answer was similar to many of the other participants' answers that were related to the skills students developed in high school and which they believed would not be a match for a Social Science specialisation. Four students mentioned that they are not good with memorizing, which they believed is important to study social sciences. In all their answers about why not choose a social science major, the five students seemed to give more value and prestige to their high school specialisation in STEM over a social sciences specialisation in high school, by holding the skills they acquired then in higher esteem. They seem to believe that studying STEM in high school requires more work that will go to waste if they choose to study a social science in university.

The results obtained in baccalaureate seem to come up often in many of the answers even when the question is about something else. The low admission grades need for certain majors seem to make them less prestigious in the eyes of some students who received higher baccalaureate results. By putting admission conditions that are based on the baccalaureate results, a certain prestige scale for the different majors and universities have been created. Despite of that, the Algerian ministry of higher education does not hold any classification of its majors and institutions. The students seem to wait for the results of their baccalaureate to use the grades they achieve as a credit to get the best possible major. This classification seems to be based on the minimum grade needed to enter the major, since the biggest employer in the country, the state, do not favour any higher education institution over the other, not the ministry of higher education has decided on any criteria for such a classification. The social and cultural views seem to be the deciding factor of such a classification.

Summing up, the data collected shows that Algerian students tend to stick to STEM fields in university if they are graduating from a STEM specialisation in high school, as shown in chart 5. Furthermore, the orientation system for new university students also plays a role in that by applying strict rules in regards of the options presented to new university applications based on the students' results and high school specialisation. In this way, the new applicants are faced with two options. Either continue within the STEM fields (only open to STEM high school specialisations), or pick one of the social sciences specialisations open to all high school specialisations (such as law and administration sciences). However, when asked "what other major would you have picked if not the one you are studying?", most survey respondents picked another STEM degree, except for three, while our interviews confirmed this trend as none of the interviewees seemed excited about a social sciences alternative. In this way, the

Algerian education system was built in a structure that encourages students to specialise starting as early as the first year of high school, while the university orientation system encourages new applicants to stick to their high school specialisation. Students, on the other hand, feel more comfortable continuing in the same path in university as they seem more comfortable and used to the skills and knowledge they acquired and developed during their high school studies within the STEM fields. They also value them more and wish to make use of them during their university studies.

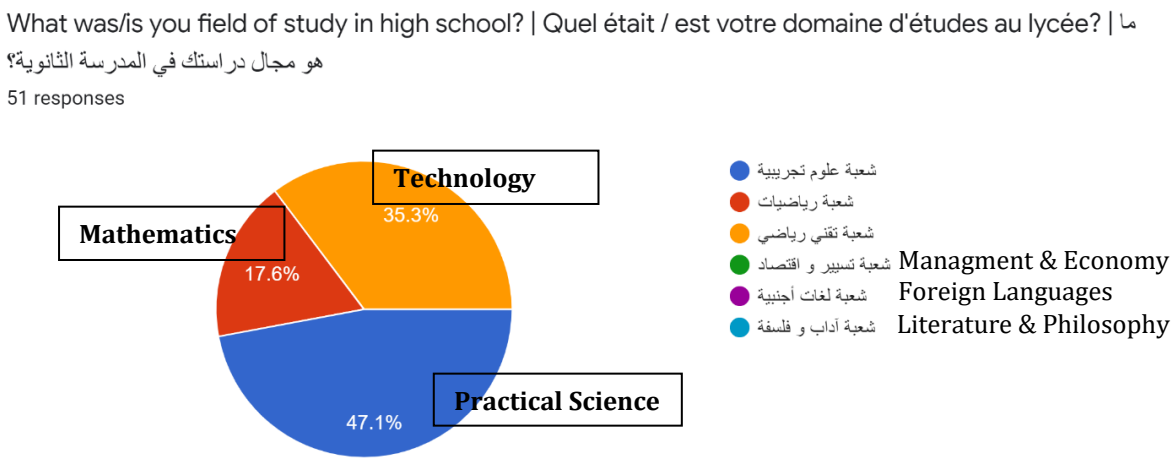

Chart 5

Theme 2: Little influence from the family

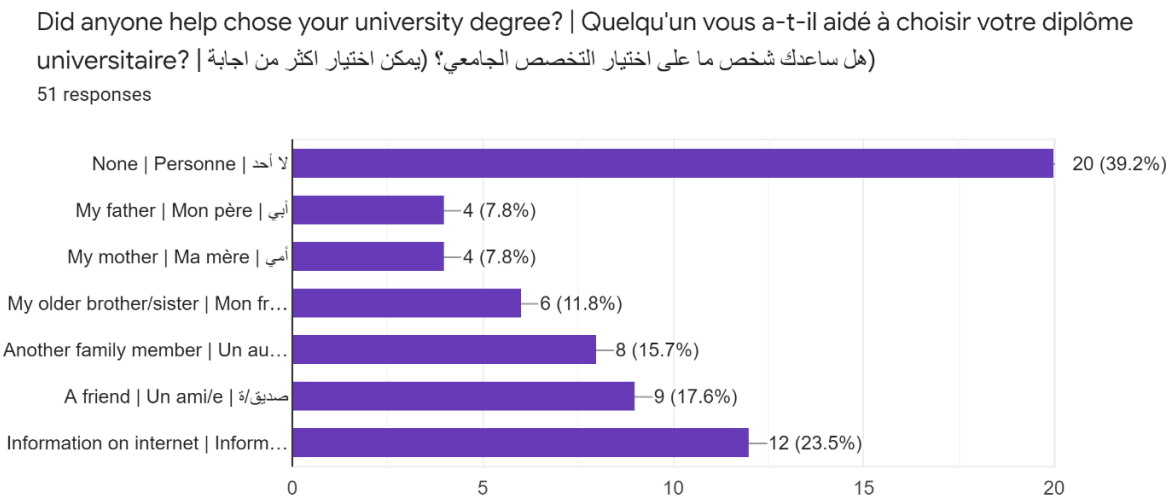

Chart 6

Looking at the collected survey data, we can see that the family members (parents and siblings) rarely influence a student's choice of a future field of study. In the survey, when asked if anyone helped the students choose their majors, 20 out of the 51 respondents answered that none did. When we look further in the data collected from the interviews, we get more clarity about the reasons behind that. The majority of the participants in the interview confirmed that they received no help from parents or siblings in choosing a field of study, although there often is a discussion around university studies. Noura, for example, said to have received advice from an older brother regarding majors not to choose in university because

> "my brother had studied mechanical engineering and found that it is not worth the efforts since the career development in this field in Algeria is slow according to him, and he advised me to look into other forms of engineering if I do not want to end up on the field smelling like oil and gas. He would have chosen something else if he could".

However, her parents did not seem to have strong opinion about what their daughter should or should not study. When asked about the kind of help she received from her parents, Namira said:

> "They were both happy for me getting my baccalaureate, but I do not think they were really able to give me much help. My father would mention during dinner what this or that friend told him about this or that major and the possibilities after graduation. My mother on the other hand, was discovering the different majors and universities as I was. She would go on forums and Facebook groups to read what people are saying about the different majors. I think, in that way, she did more research than I did. I appreciate the emotional support they gave me, but I do not think they affected my choice of major. At a certain point I had to put medicine in the top position knowing I will not get it, just to make my mother happy. She keeps saying that you never know".

Similarly, Nadia confirmed receiving an indirect support from her parents who did not go to university.

> "Although my parents did not go to university, I received total support and they backed my choice. I felt more confident having their support. I am sure they would have wished that I study medicine or pharmacy, because that is all "the good" degrees they know about", she said.

Nadia although aware of what the social and cultural norms define as a prestigious degree and what is a good field to study, she does not seem to automatically follow and accept those norms. When asked if her parents were disappointed after she got into the University of Boumerdes, Nadia seemed to be happy about the moral support she got from her parents during the orientation process and after the results announcement. She said:

> "I think my mother knew deep inside that I will never get the options she was hoping for, so I don not think she was disappointed. On the other hand, my father seemed proud of the result. One of his friends have a daughter who studied in Boumerdes and who is now working for Sonatrach (the Algerian national oil company). He was proud I got into a prestigious major. Both of them were happy anyway, and that made me extra happy about my results".

Similar comments were made from two of the three participants who received no help from family members to choose a degree. Namira mentioned that her parents do not know much about the degrees offered at the university nowadays because the higher education system changed a lot.

> "I know a lot of people who have studied Science and Technology and they all say it is an ok path to choose. I talked with many of them before and I always knew that it is what I would choose. All that matters for my parents is that I study in Chlef (her hometown) because the student's life when away from home is really tiring from what I hear",

she added.

When asked who they discuss their choices and options with, the recurring answers in the interviews are friends from high school, cousins, and Facebook groups. In the survey results, 12 respondents mentioned getting help from the internet to know more about the degree and future possibilities. 17 participants said to have received help from friends or family members other than their parents and siblings to get more information about the different degrees they are interested in. The main information they seem to look for is what subjects are studied within the degree.

Algerian students seem to have total freedom in choosing the degree they want in university (within the restrictions of the Algerian higher education explained above). 31 of the 51 survey

participants (59%) said that none tried to convince them not to choose the major they picked (Chart 7), while 15 people said that one of their parents tried to convince them not to pick the major they chose but they still went with their preferred choice. As for the reasons of objections parents mention, three survey participants said that their parents did not think that the major their daughter was choosing was suitable for a girl. The survey's data shows that this applies to girls who chose degrees that require a presence outside the office and in open spaces such as civil engineering and mechanical engineering. Other respondents mentioned reasons that are more related to the difficulty of the major itself, job opportunities after graduation, or the parents' preference of another major (Medicine was the most mentioned). However, all of this do not seem strong enough of an objection to convince the students not to go with the major they already chose.

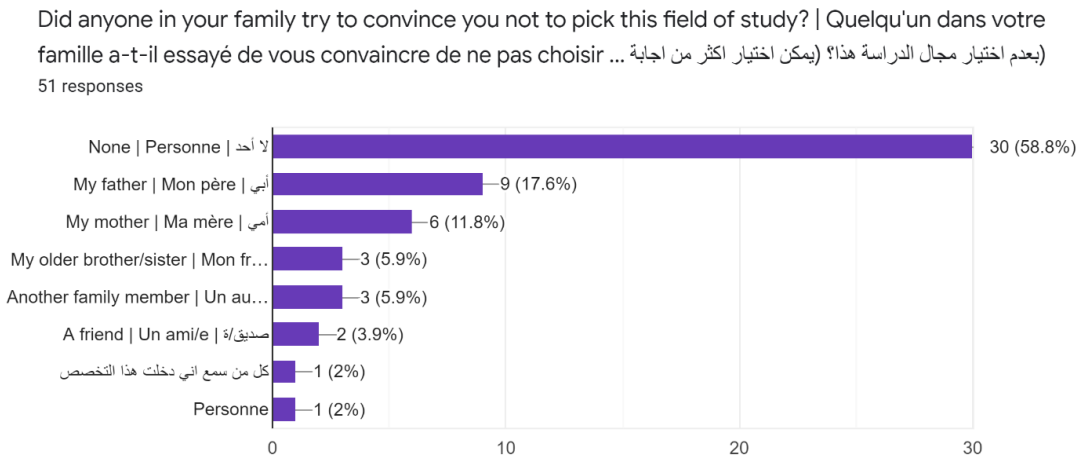

Chart 7

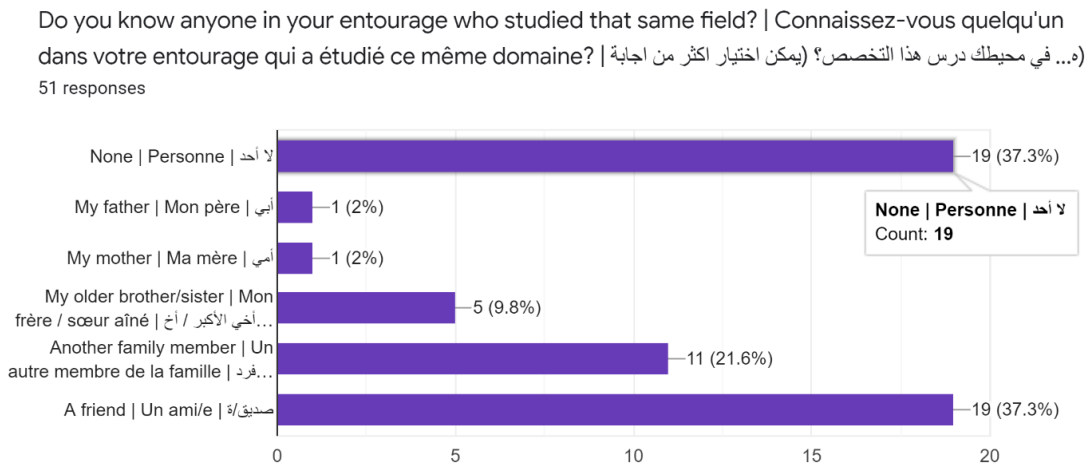

Chart 8

Although the direct influence of the people around the student choosing a major seems to be minimal and have little effect over their choices, the indirect influence seems to be more important. When asked whether they knew anyone who studied the major they picked (Chart 7), 37 of the 51 respondents answered that they knew at least one person who studied the same major. While students participating in the survey seem to have a great amount of freedom when choosing a major, these choices might be indirectly influenced by what they see around them and there might be higher chances for an Algerian student to pick a major already studied by someone they know. These observations based on the data collected from the survey are further confirmed in the interviews where the interviewees often referred to the conversations with friends and family members as part of their university orientation process.

When asked "How do you think your entourage affected your choice of a field of study at the university level?", answers were different as some of the participants linked their answer to trust saying that their family trusted them enough to be given total freedom to choose what they think is best for their own future and that trust seem to have been interpreted as a sign of approval and encouragement. These interviewees seemed to have a clearer target and understanding of what they want to achieve and how to get there compared to others. Nejma, 20, who is studying IT at the university of Mohamed Boudiaf in Oran, thinks that her major is the easiest way to become an IT engineer.

> "I knew I did not have the needed marks to get to ESI (Ecole Superieur d'Informatique,a prestigious IT university in Algiers) but I have the opportunity to study the exact same

things at any university, plus, nowadays you can find everything you need to learn on the internet. There was no point in arguing about it, everyone knew what I was interested in and they respected that. The choice was easier to make and go through with that way". She added.

when asked "Do you think your parents or entourage would have given you as much freedom to choose if you were to choose ESI?", she answered:

> "You know how it is in Algerian families. They would prefer that their daughters stay within eyesight, but I do not think my father would have stopped me from going to Algiers, especially since he has family there. My mother would have wanted me to stay in Oran for sure. You know, my parents did not go to school, and they are proud that all their kids did. They were devastated when I did not get my baccalaureate the first time, they were so happy when I got it, I do not think they could have said no to anything I would have asked for. They are conservative, but they know they educated us well".

The other three participants linked entourage's effect on their choice to the wider society and what society thinks women can or can not do, rather than family. There was a general agreement that it is not easy to pick a degree "in a men's field" because a female student might be judged later after she graduates and starts looking for a job or in the job itself, "but who cares what others think as long as you are getting the job done, that is all that matters", said Noura.

> "I hear a lot of concerns from other female students in the field. Most of the graduates in my major would work for Sonatrach or for an international oil company. Many links it to work on the oil fields in the desert, in the middle of nowhere. I know many in my major, male and females, who think that such a job is not for women. Personally, I do not think these concerns are valid or serious enough to stop me or anyone who picked this major from going through with this choice. If it was, we would not see so many women choosing oil related majors, but I imagine many might be discouraged by what neighbors or extended family members might think of them. Plus, there is a lot more you can do with an engineering degree in Mechanics, you do not have to end up a 2000 km away, in the middle of nowhere, along among a bunch of men."

Nadia, who is a civil engineering student, admits having become a bit worried during university about her future work environment:

> "You hear stories where you are in university, and it makes you think. Working in a male dominated field will not be easy. I get sexually harassed daily on my way to work, imagine how it would be on the construction sites. I never worried about this before because I always believed that each person could impose respect around them at work, but the harassment stories we hear nowadays makes me worry a bit", she added.

Like Noura, Nadia is aware of the expectations the society has for women in her position, however choses to resist and fight those norms by go through with what she believes instead of adhering to the social norms she grew up learning and hearing about.

When asked "Would you have chosen a different major if you knew what you knew now at the university orientation stage?", Nadia answered:

> "I do not think I would have. I did not really know I was going to study what I am studying today. Plus, whatever you study there will always be this risk of sexual harassment. They are not less because you are a teacher or a doctor. Many men prefer to marry teachers and doctors because they think it is a more honourable job for a woman, but on the contrary. There will be higher chances to be sexually harassed when you work indoors with a closed door. I am sure it happens to all Algerian women; we just choose to not talk about it because most women are afraid of hchouma".

Hchouma can be translated as shame, sometimes as "losing face". It is mostly linked to honour and linked to all the family. In Algeria women are often left to deal with the "hchouma" and its repercussions such as having to marry their rapist to protect their honour, and consequently, and that of the whole family, especially of the rape incident leads to a pregnancy. In some very conservative regions, acts as simple as going out with friends, spending the night out, going alone on a car trip, or ant act that could "tarnish" a girl's reputation can lead to serious consequences for the girl and the honour of her family. The same does not apply to guys.

When asked "Do you personally know anyone who worked in your field of study?", Nadia and Namira said to personally know such a person. Noura, after starting her PhD, got to meet and work with many in her field but they were mostly man.

> "Many women do study mechanical engineering but still very few pursue a career in this field. It is mostly men that that I work with when I am on the field for something practical. Most women prefer academia and research over working in companies and

> on the ground. Most of those who studied with me are now married and with kids and decided to be a housewife",

added Noura with a tone of regret.

Nour and Nejma both knew women who studied their same degrees but did not work in the field either because they got married and did not go on to look for work after graduation or because they found jobs in other fields after graduation.

After looking at the data of the survey and that of the interviews, it became clear that women in Algeria are fully aware of the challenges facing them being a woman, whether that is judgments from parents and family members regarding how fit they are for the degree or society's expectation of what gender can or should be working in this or that field. However, those who decide to pursue a major within the STEM field do not seem to let their education related choices be dictated or affected by their social environment. All the interview participants seem to be aware of stories of other women in their same position and who have gone through the same majors and degrees. However, these participants' choices do not seem to be affected by that since this in depth knowledge is not available at the university orientation stage, but rather later once the student starts university, therefore, it does not seem to have major effects on the students' choices. Even though Algerian women know these things are happening and the challenges a male dominated society represent, they choose to be part of a working environment that is highly gendered. This perhaps reflects a desire to change things from within. In one way, this might be proving that the activism highlighted earlier (pp. 10-12) could be bearing fruits. Things are slowing changing and women taking up jobs in male fields is also part if that change.

Since the majority of the survey participants (37 out of 51) said to have personally known someone who already studied their major, and because most of the interviewees seemed to have a realistic understanding and expectations of future risks of the jobs within their fields of study, we assume that students who already know people within a certain field might be encouraged to go the same way. However, this needs to be studied further because the scope of this study took into consideration those who successfully challenged society's norms and resisted any negative influence of people or tradition that might discourage them from choosing a STEM field. A study is needed to look further into the choice of those who opted not to follow a path within a STEM field in university and the motivations behind such a choice.

Theme 3: Students' self-awareness, awareness about the economy and society:

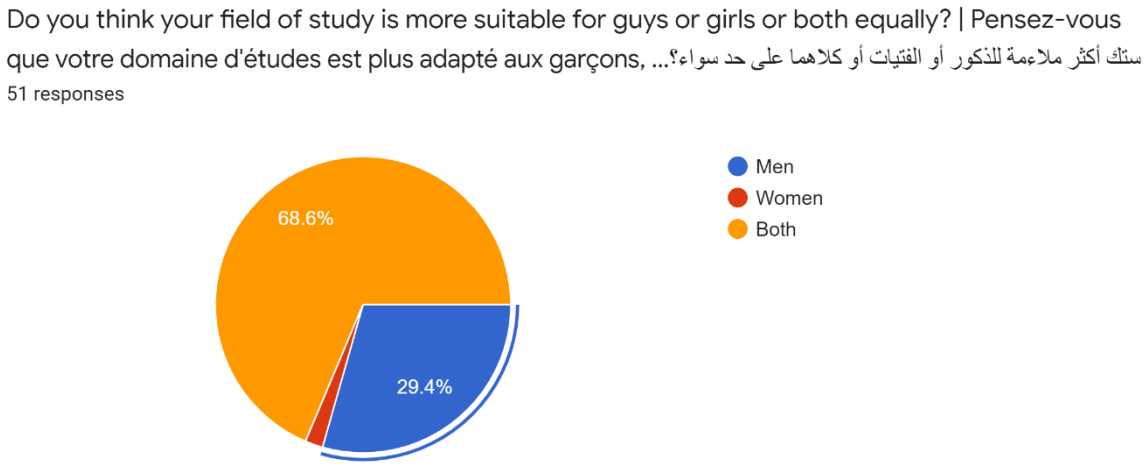

Chart 9

As seen under Theme 2, Algerian female students have proven to be well aware of the social challenges and the difficulties that might arise in the future when working within a male dominated field. This realistic view of the Algerian society is further noticed in other parts of the data collected from the survey.

When asked if their field of study is more suitable for men or women (Chart 9), most participants in the survey answered that it is suitable for both with about 69%. Only one person, constituting 2% of all survey respondents, judged her field of study to be more suitable for women, while 29.4%, or 15 people, think that their STEM field of study is more suitable for men than women. The majority of these 15 opinions were those of men (12 respondents) while only three women who shared that opinion. Noting that both male and female STEM students participated in this study, it is interesting that there are female STEM students among the 29.4%.

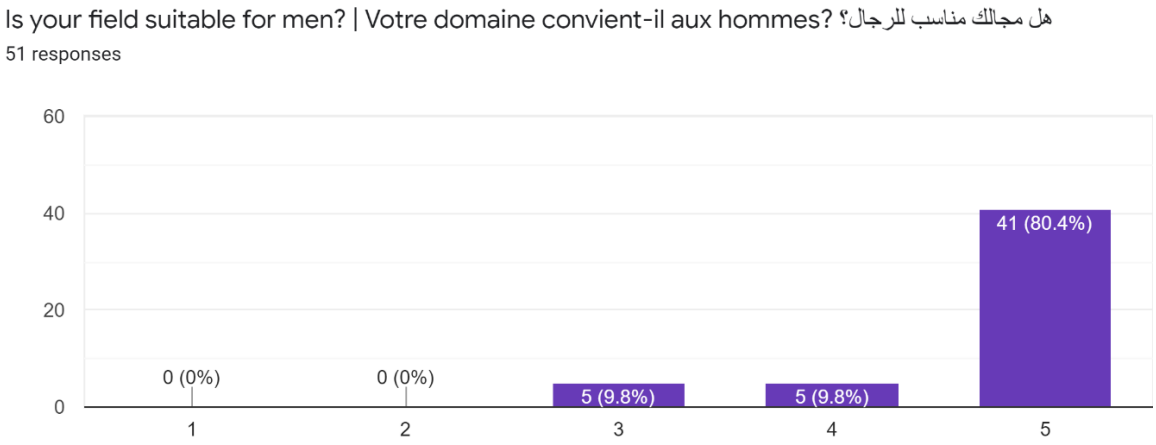

Chart 10

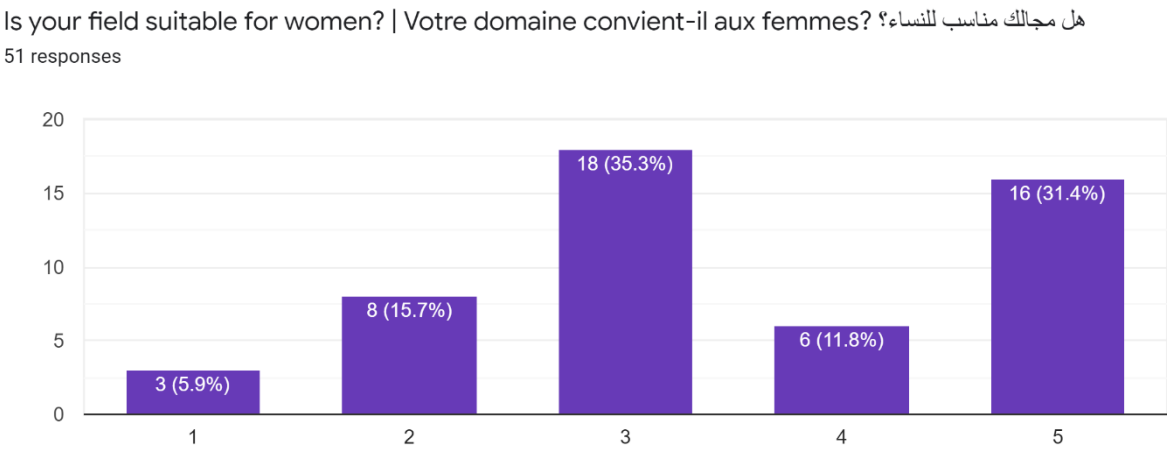

Chart 11

The survey also asked the participants “Is your field suitable for women?” and “Is your field suitable for men?”, requiring them to rate the suitability of each gender for the field they are studying from 1 to 5, the latter being an excellent suitability for their STEM field of study, and 1 being no suitable at all. Result came us as shown in Chart 10 and Chart 11. While we predicted that most men would rate their suitability as a five and women’s suitability less, it was surprising to have a majority of women rate their suitability for the degree below that of male students within the same field. Among all the female STEM students who thought that their STEM field of study is suitable for both men and women (21 female survey respondent),

13 thinks that their field of study is more suitable for men than women. Although these female STEM students believe that their field of study is suitable for both genders, 9 would rate males' suitability as a 5 (excellent) and rate females' suitability as a 3 (medium). These respondents mostly study mechanical engineering, civil engineering, fluid mechanics, and geology. All of which are considered fields that require a high degree of work outside and on the field, with mostly men as colleagues. On the other hand, one female electronic engineering student gave male suitability for her field of study a 5 and female's suitability a 4. Electronics is a field of study where most of the work is done indoors, in labs, or on a laptop, very similar to the work environment within the IT field for which all female students judge the gender suitability to be 5 for both genders. It seems that even for Algerian female students who believe that their field of study is suitable for men and women, there remains many who think that certain fields are more suitable for men, mainly based on the work environment after graduation. Nevertheless, this does not seem to be a factor that deters these female students who participated in the study from going through with their plans to study the STEM field they chose. This goes to prove that concerns over the workplace conditions and suitability for different genders are not part of the though process of female students when choosing a major, and therefore does not affect their choice of field of study.

These results were further confirmed in the interviews when we asked interview participants to describe their experience as a female student their universities as compared to a male student. 4/5 said that female students study harder than male student. When asked why, one interviewee said that female students have less distraction during their semester than male students because they mostly stay in the dorms while male students like to play sports hangout till late and sit in coffeeshops.

> "There is nothing really you can do in Chlef as a student except study. Guys have more freedom to move around, go on trips, sit in coffeeshops, and spend the night out. The girls' dorm closes its doors at 9pm, what else would you do inside your dorm if not study?", said Namira.

Noura explained that girls are expected to perform well:

> "Many girls come very far to study, and they know they are lucky to be allowed to, so they better prove to be worth such a trust. You do by successfully passing each year. I

> do not think I know any girl who failed passing her year. Girls just study harder.", Noura added.

Nour had similar comments with more focus on what females cannot do.

> "As a female I cannot go out as I please, from class to the dorm and from the dorm to the class mostly. You have to focus on your studies because that is what your parents sent you to the university to do. I need to get good grades otherwise my parents will start wondering what else I am doing here (she means bad things) and whether it is worth living this far from home".

Just like Nour, all five interview participant are aware of what society is expecting from them. There is so much talk and comments about what is expected from students based on gender. Therefore, cultural perceptions steer students to be close to home. Or if not, they live with these expectations of being good.

There was a general agreement among all five participants that there were no apparent differences between male and female students in their field when it comes to the ability and suitability for the field of study. Several answers kept coming up, such as "It is the 21st century, your ability does not depend on your gender", "all depends on your efforts, not gender", and "we all have the same capacities". However, when asked if they can imagine any differences between men and women in their STEM field after graduation and starting work, all participants raised some concerns.

> "There would probably be differences at work, especially if you are working for the private sector. I think men have better chances to be hired by the public sector because they can work anywhere and at any time. The state does not care about your gender as long as you are getting the job done, but the private sector would want to abuse you as much as they can but they can not do that if you are a women because they know you have to get home at a specific time and you can get pregnant and you get sick every month (she means the period). A company owner might just prefer to make his life simpler and higher a man", explained Nour.

Nadia had concerns about her future husband saying that

> "Some men do not like to have a working wife, especially if she makes more money. I know many women who had to stop working because their fiancé or his family do not want them working outside. I am afraid I might reach a point where I would have to choose between getting married or working. It is still far, but you know, it is this way in Algeria. They only like teachers and doctors".

Namira said that men might have better chances of getting a job because they have more freedom to travel wherever jobs are available

> "They can work for any company without being afraid of any sexual harassment they might face; they do not face any. They won't be judged by family or cause any shame for working night shifts for example. To get a decent job in IT I would probably need to go to Algiers where all the companies are. First problem: none would rent to a single woman living alone. There are just less chances if you live in a little province like Chlef", added Namira.

Moreover, to go further in the work condition after graduation, and with the aim to look into whether female students choose STEM majors in the look for a better economic future, we asked students how they see their employment chances after graduation by rating them between 1 and 5 (Chart 13), 1 being almost impossible to find a job and 5 being very easy to find a job within the STEM field they are studying. As seen in the result on Chart 13, only one (2%) of all survey participants thought that finding a job within their field of study is easy (rate 5) and four (7.8%) rated their chances of finding a job after graduation a 4. The majority of participants rated their chances a 3 or bellow. 24 students (49%) rated it a 3, 19 participants (37%), rated it a 2, and two (3.9%) participants rated it a 1, meaning nearly impossible to find a job. Having made the choice to study a specific STEM major, Algerian students seem to have a clear understanding of the economic reality of the country. Under the reasons behind their rating, some students mentioned the lack of economic investments in their field, the difficult economic situation of the country, the lack of foreign investments, or the high number of graduates compared to the number of jobs available. Therefore, their choice of a STEM field is not motivated by their hope for a better economic future since they are clearly aware that their degree is no guarantee for a job after graduation. This goes to say that Stoet and Geary's assumptions regarding the reasons behind Algerian female students of a STEM field in higher education is not correct.

6 Concluding Remarks

In the light of Stoet and Geary's gender equality paradox in STEM, in this thesis, the aim was to explore whether life-quality pressures in Algeria push girls and women to choose STEM fields as a subject at the university level in a look for financially more rewarding occupations. The research was designed to shed light on the elements that motivate women's choices when picking a field of study at the university level in Algeria. We had the following research questions:

1/ What considerations do female Algerian students have when choosing their university degree?

2/ What/who influences their choices?

3/ What kind of policies implemented by the Algerian government could have influenced the male/female ratios in STEM fields at the higher education level?

The data collected in the course of this study has clearly rejected Stoet and Geary's assumptions and has shown that Algerian female students do not choose to pursue STEM field studies in university in a look for better economic prospects. On the contrary, they are fully aware of the poor economic prospects of their STEM degrees in Algeria, the risks women face in a male-dominated field of work, and the difficulty of the major itself as a challenging field of study.

There seem to persist a constant lack of proper help and guidance at the university orientation stage for all Algerian students, males and females, pushing them to turn to friends and relatives for advice. Additionally, Algerian female students receive little direct influence from their parents and siblings. Still, they seem to have their choice of university major indirectly influenced by friends or family members around them as they have more chances to pick a major if they know someone who studied it before. This person would be an alternative source of information and guidance and constitutes the female students' first access to a new network. This would allow them to build social capital, which can be a significant hindrance in women's path in STEM. The lack of social capital and robust social networks and relationships that provide essential things like material resources, knowledge of grants and opportunities, and other career-advancing support can be one of the reasons behind women's flight from STEM (Korte & Lin, 2013; Rhoten & Pfirman, 2007). Furthermore, a broader exposure to successful

role models has the potential to encourage girls to retain their interest in science and to reject the stereotype that careers in math and science are for men (Wang & Degol, 2017).

Female STEM students in Algeria seem fully aware of the challenges they face for being a woman. Whether it is judgments from parents and family members regarding how fit they are for the degree, or society's expectation and limitation regarding what fields each gender should be working in, or how they can or can not spend their time in university. However, they still make a choice to follow a degree within the STEM field armed with that full awareness about these realities of the Algerian society. A prove that the activism for women's rights and against outdated laws and traditions in Algeria, dating back to the 1980s, is slowly bearing fruits and changing minds. Women continue to step into traditionally male-dominated fields such as the STEM fields despite the chilly, unwelcoming and threatening academic environment for women (Casad et al., 2019).

This study has shown that female Algerian students, just like male students, are encouraged by the Algerian education system to continue within the STEM field in higher education if they graduate from a STEM specialization in high school. This is thanks to a university orientation system that limits their options and allows students graduating high school to choose only majors that fit best their past studies and baccalaureate results. Therefore, the Algerian university orientation system starts in reality in high school when each student chooses a specific field of study. It allows, as a result, to counterbalance the discouragement that female students might feel because of the Algerian patriarchal society norms. In addition, and to refer to the literature review, this counterbalance would not be possible without the Algerian female students' superiority in foreign languages and reading ability compared to Algerian male students (Heinzmann et al., 2015) (Mbarki, 2011). In their research, Stoet and Geary (2020) highlight a similar case of gender parity in STEM higher education in Mexico despite having one of the least positive attitudes towards women's enrolment in university. Considering that Mexican boys do not read as well as Mexican girls, it seems that the disadvantages faced by both Mexican boys and girls cancel each other out to produce a seemingly equal gender distribution (Stoet & Geary, 2020). Similarly, the Algerian orientation system coupled with girls' superiority in reading and foreign languages cancels the disadvantage of the lack of gender equity in the Algerian society, allowing Algerian girls to be more present in STEM fields in higher education.

By allowing for specialization since high school, the Algerian education system allows students to build a significant credit of knowledge that they prefer to invest in higher education instead of letting it "go to waste" by choosing a degree within a new field of study that would not require the knowledge they harvested during the four years spent in high school. In addition to that, by creating a university orientation system that rewards the best performers in the baccalaureate with more freedom when choosing a degree, baccalaureate holders try to invest their baccalaureate to get what they believe is the best degree possible. This ranking is decided based on the minimum grade required for applying for a major and the degree of demand from new students, while the admission is purely based on the student's baccalaureate results. In this way, the Algerian university orientation system has become a system that gives importance to hard work and effort in achieving success in university in general and provides extra support for growth within the STEM fields by providing students the opportunity to improve through a year of general studies in their first year even when their baccalaureate results do not allow for a direct access to a STEM specialisation. A strategy that gives importance to effort instead of talent, leading us back to the discussion by Dweck. This has proven to be encouraging for women to venture in the STEM field since a major factor influencing women's underrepresentation in math-intensive fields is the fact that they are less likely to pick occupations that are perceived as requiring innate intelligence and skill, which includes math-intensive fields. In order to counter this, it is essential to highlight the importance of hard work and effort in achieving success in math-intensive occupations and support a growth mindset in girls (Dweck, 2007).

This study looked at the inequality in STEM from a sociological lens that identifies gender as a social structure in order to uncover the factors that come into play in the Algerian context, proving the importance of a gendered perspective in research. The gendered perspective of this study reveals that Stoet and Geary's assumptions about the economic benefits are not applicable to understand the situation in Algeria. Critical gender theorists suggest that gender consists of a multitiered and connected system consisting of the macro level, including politics, culture and economics, the micro level, including personal exchanges, and the individual level, which involves internalized values and beliefs (Eisenhart & Finkel, 1998; England, 2010; Risman, 2004). Therefore, some researchers believe that we should further study how STEM domains fit within the larger gender inequality structure instead of focusing on them separately. The empirical data of this study shows that this has relevance. The institutional and cultural logics in the Algerian society have promoted and maintained some gender essentialist beliefs

that persist even among those who choose to step into male dominated fields like the case of many in our case study. Therefore, cultural perceptions steer students to conform to the society's expectations, or if not, they live with these expectations as being good. This might cause many in Algerian STEM female students to question their suitability for the Stem field they chose.

While cultural practices and perceptions could push girls and women to drop out of every stage of what researchers have termed STEM "leaky pipeline", the data shows that the education system in Algeria was able to prevent this from happening once they are within STEM fields. Thanks to an early specialisation within the first years of high school, this study shows that those who chose a STEM specialisation would rather continue within the STEM field in university. Research has also shown that interest and aptitude are equal determinants of individuals' career choices. For example, girls with high math skills and little interest in STEM fields are far less likely to pursue science degrees than individuals with average math achievement and high interest in scientific subjects (Tai et al. 2006). The Algerian education system seems to have this in place, giving girls the chance to grow interest in STEM as they grow their STEM skills throughout high school. Although they have the option to change to non-STEM fields both in high school and university, the data in hand shows that many choose not to. This is further backed by a university orientation system that gives those who do not perform well enough in STEM a chance to improve through different STEM general studies programs. These programs open up new doors towards more STEM specialisation, focusing in this way on improving students skills through effort rather than just focus on talent. This system has built the culture needed among students to capitalises on a growth mindset, especially among girls, so that they understand that STEM related skills are strengthened through effort and persistence as mentioned earlier (Dweck, 2007). These STEM skills which Algerian students developed during their high school years are held in high esteem and female students prefer to use them further in their studies once they are acquired, as the data of this study has revealed.

This research has looked into what previous studies have identified as causes for this education gender equality paradox across the developed countries where the paradox persists and, against that backdrop, explore the situation in Algeria, a developing country where the education gender equality paradox does not exist.

Several other aspects that could affect Algerian female students' choice of field of study have been noticed in the course of this study but could not be investigated further due to its scope. Among these, how social sciences are looked at and valued by STEM fields' students, how is the student's choice of a degree affected by people they personally know in that field of study, and group peer pressure effects on the choice of a field of study as most STEM specializations highs school students seem to want the same things which lead to the creation of the present Algerian orientation system that is based on merit and a structure of prestige for the different majors.

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