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Enhancing Policies on Promoting Gender-inclusive and Equitable Quality STEM in Higher Education

Directions and challenges from a comparative analysis between Italy and China

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Declaration

The doctoral thesis is a result of my investigation and research while supervised by Professor Chiara Biasin, which has never previously been accepted for any degree.

Abstract English

This explanatory and exploratory PhD study aimed at fostering gender inclusivity, equity, and high-quality higher education focusing on two countries Italy and China. Investigating the directions and gaps pertaining to STEM gender equality higher education policies in Italy and China, the thesis takes advantage of expert interviews to enhance knowledge on policy challenges and educational directions.

The policy comparison adopts the framework of Bray and Thomas Cube that focused on three dimensions: geographical location (Europe and Asia: Italy and China); non-geographic population groups (women in STEM HE), and draws upon the Analysis Framework for Mapping Inclusive Education Policies, the aim is to analysis the policies from dimensions of vision, implementation, vulnerability, framework and need.

To accomplish these objectives, this thesis employs qualitative research methods alongside thematic analysis to critically evaluate policy documents and expert interview findings. Thematic analysis is employed, facilitated by ATLAS.ti software.

The outcomes of this cross-cultural comparison reveal a lack of consistency in policies promoting gender inclusion and equality within STEM higher education in both Italy and China. The gender perspective in educational policies sometimes is missing, and the matter of gender equality within higher education receives insufficient attention.

In the future, policies should commence by enhancing the focus on gender inclusivity, equality, and quality within higher education visions. Emphasis should be placed on altering teaching methods to address institutional gender imbalances within higher education. Furthermore, identifying gender equality obstacles within STEM departments through the collection and monitoring of specific data across various majors is imperative. Establishing a long-term action framework for addressing gender equality in higher education is also warranted. Additionally, the establishment of gender equality institutions in department level within higher education institutions are essential steps toward formulating, implementing, and monitoring gender equality matters within higher education.

Abstract Italiano

Questa ricerca esplorativa ha avuto come obiettivo la promozione dell'inclusività di genere, dell'equità e dell'alta qualità nell'istruzione superiore sia in Italia che in Cina. L'indagine si sviluppa sulle direzioni e sulle lacune relative alle politiche di parità di genere nell'istruzione superiore STEM in Italia e in Cina e s'avvale di interviste a esperti per approfondire la conoscenza delle sfide e delle direzioni delle politiche.

Il confronto delle politiche adotta il quadro sviluppato da Bray e il "Thomas Cube" concentrandosi su tre dimensioni: posizione geografica (Europa e Asia: Italia e Cina); gruppi di popolazione non geografici (donne nell'istruzione superiore STEM) e si basa sul Quadro di Analisi per la Mappatura delle Politiche di Educazione Inclusiva per analizzare le politiche sotto i parametri di visione, implementazione, vulnerabilità, struttura e necessità.

Per raggiungere questi obiettivi, questa tesi utilizza metodi di ricerca qualitativa insieme all'analisi tematica per valutare criticamente documenti politici e risultati delle interviste agli esperti. Si fa uso dell'analisi tematica, facilitata dal software ATLAS. ti.

I risultati di questo confronto interculturale rivelano una mancanza di coerenza nelle politiche che promuovono l'inclusione di genere e l'uguaglianza nell'istruzione superiore STEM sia in Italia che in Cina. La prospettiva di genere nelle politiche educative talvolta manca, e la questione dell'uguaglianza di genere nell'istruzione superiore riceve una quantità insufficiente di attenzione.

In futuro, le politiche dovrebbero l'indagine migliorando il focus sull'inclusività di genere, l'uguaglianza e la qualità entro una visione complessiva dell'istruzione superiore. Dovrebbe essere posta particolare enfasi sulla modifica dei metodi di insegnamento per affrontare gli squilibri di genere istituzionali nell'istruzione superiore. Inoltre, è imperativo identificare gli ostacoli all'uguaglianza di genere nelle aree STEM attraverso la raccolta e il monitoraggio di dati specifici relativi alle diverse specializzazioni. La creazione di un quadro d'azione a lungo termine per affrontare l'uguaglianza di genere nell'istruzione superiore è altresì necessaria. Di particolare importanza è il potenziamento della formazione sulla sensibilità di genere per gli educatori e l'implementazione di sistemi di orientamento professionale attenti al genere. Inoltre,

l'istituzione di organismi per l'uguaglianza di genere dipartimento all'interno delle istituzioni di istruzione superiore è un passo essenziale passi essenziali per formulare, attuare e monitorare le questioni di uguaglianza di genere nell'istruzione superiore.

Abstract Chinese

这项解释性和探索性研究的目的是在意大利和中国促进高等教育的性别包容性、公平和高质量。通过对意大利和中国 STEM 高等教育中性别平等政策的方向和差距的调查，通过专家访谈，加深对政策挑战和方向的了解。

政策比较采用了 Bray 和 Thomas Cube 框架，重点关注三个方面：地理位置(欧洲和亚洲：意大利和中国)；它以绘制包容性教育政策地图的分析框架为基础，根据愿景、实施、脆弱性、结构和需求分析政策。

为了实现这些目标，本文使用定性研究方法和专题分析来批判性地评价政策文件和专家访谈的结果。使用 ATLAS. ti 软件辅助的专题分析。

这种跨文化比较的结果表明，在促进意大利和中国在 STEM 高等教育中纳入性别和平等的政策方面缺乏一致性。在教育政策中，性别观点有时是缺失的，高等教育中的性别平等问题没有得到足够的重视。

今后，政策应首先更加注重高等教育的性别包容性、平等和质量。应特别强调改变教学方法，以解决高等教育中的结构性性别不平衡问题。此外，必须通过收集和监测关于不同专业的具体数据来确定系统部门中性别平等的障碍。还需要建立一个处理高等教育性别平等问题的长期行动框架。特别重要的是加强对教育工作者的性别敏感性培训，并推进对性别敏感的职业指导制度。此外，在高等教育机构内设立部门一级的性别平等机构是在高等教育中拟订、执行和监测性别平等问题的关键步骤。

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Abbrevations

STEM	Science, Technology, Engineering, and Mathematics
HE	Higher Education
WEF	World Economic Forum
ED	International Standard Classification of Education (ISCED)
NBSC	National Bureau of Statistics of China
MOEC	Ministry of Education of the People's Republic of China
SDG	Sustainable Development Goal
EASNIE	European Agency for Special Needs and Inclusive Education
CPRA	Country Policy Review and Analysis
UN	United Nations
EASNIED	European Agency for Special Needs and Inclusive Education
AFMIEP	Analysis Framework for Mapping Inclusive Education Policies
CEDAW	Limitation of All Forms of Discrimination Against Women
ICE	International Conference on Education
ISTAT	Italian National Institute of Statistics
PNRR	National Recovery and Resilience Plan in Italy
WB	The World Bank
MEC	Ministry of Education of China
NBSC	National Bureau of Statistics of China
EIGE	European Institute for Gender Equality
GEP	Gender Equality Plan
ACWF	All-China Women's Federation
GDP	Gross Domestic Product
NSLCAS	National Science Library, Chinese Academy of Sciences
CEEP	College Entrance Examination in the Palm Website
CCP	Communist Party of China

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INTRODUCTION

As a researcher from China, I pursued science education during my high school years (in Guangxi, the Chinese province where I lived at that time, high school education is divided into science and liberal arts majors) and studied biological science for one year in college. Subsequently, I altered my major owing to apprehensions about career prospects and lack of personal interest and sense of belongings to the subject. Based on my personal experience, I can sense the pervasive presence of gender stereotypes within our society, particularly within educational periods, which undoubtedly an inequality to women. In high school, I was questioned about girls' ability to learn science for many times. In my freshman year, despite the male-to-female ratio in the School of Biological Science being 1:4, I still perceived a sense of inferiority and inequality for women in terms of professional education and employment opportunities. As an illustration, during laboratory experiments, instructors often encouraged students to pair up with male partners to handle challenging tasks. In a similar vein, I came to learn and believe that female undergraduate and graduate students in this field encountered more significant obstacles in obtaining employment and received lower salaries than their male peers, even if they were successful in obtaining suitable job positions · which also constitute one of the important reasons for my transforming major. However, it was also observed that obtaining a higher academic degree, such as a doctoral degree, could lead to better job prospects within the field for female student in the field. It is difficult to estimate the influence of gender stereotypes on women's right, which take gender as the evaluation standard, no matter in the school environment or the social environment. How to overcome the negative influence of gender stereotypes on women's learning and growth is an important aspect of women's empowerment. I am currently studying in Italy, which has enabled me to compare two distinct cultural spheres - Western and Eastern cultures at the macro level, and Italian and Chinese cultures at the micro level - to observe and reflect on Chinese and Western attitudes and measures on promoting gender equality in STEM(Science · Technology, Engineering,

Mathematics) in the higher education institutions and advancing the knowledge on the issue of gender equality in higher education from a comparative and international perspective.

To begin with, the paper will examine the background of the evolution of women in higher education and highlight the gender equality factors in STEM fields. Women's participation in higher education has made remarkable progress in recent decades. From 1970 to 2022, the global higher education system has grown from 33 to 235 million, an increase of almost eightfold, meanwhile the growing speed of women enrolling in higher education has grown to almost double that of men, making them the dominant gender in this field. (UNESCO,2012; UNESCO,2022) The trend of contemporary higher education development towards mass higher education and even higher education universalization has reversed the tide of those who are usually unable to access higher education, such as women, people with disabilities, the disadvantaged and poor, ethnic minorities (BAME), and other vulnerable groups, thus providing an opportunity for people from diverse groups and classes to fully develop their potentials. The research and actions focused on diversity, inclusion, and equity in university to release potential of all the students attracted attention (Dewidar et al, 2022; Scott, 2020). Despite the progress of women's participation in higher education made, the World Economic Forum (WEF) believed that at current rate of progress, it will take 132 years to reach full parity (WEF, 2022). The empowering women issue is one of the most important issues around the world. Achieving gender equality and empowering all women and girls is through quality education belong to the fourth and fifth goal of the UN's 2030 Sustainable Development Agenda. It claims in the agenda that we should promote inclusive and equitable quality education by closing the gender gap in education, promote education for gender equality, and promote inclusive learning environments. Moreover, gender equality is not only a fundamental human right, but a necessary foundation for a peaceful, prosperous, and sustainable world (UN,2015). In higher education, the World Bank gender Gap report says, there is still a significant gender gap between different departments in universities (WEF,2022). Take STEM fields, which are essential for a nation's competitiveness, as an example: globally, female students are heavily underrepresented. Participation of women in STEM programs varied from less than 1% in the

Maldives to 41% in Oman. In 2017, within the OECD, only 30% of new enrolments in bachelor's degrees in STEM fields were women (OECD, 2020; UNESCO, 2020a). Not to mention the leakage of women when it comes to high-level degrees that men occupied 54% of graduates in the PhD programs (UNESCO,2016). In fact, apart from Science, Mathematics and Computing (where women constituted less than 40% of the PhD graduates), and Engineering, Manufacturing and Construction (where women accounted for 26% of the PhD graduates) (EU, 2013) · there is almost parity between women and men or even more women. In the leaky

STEM pipeline, the number of women has decreased significantly with the increase in education. Moreover, women's increased presence in higher education does not necessarily translate into higher wages or equal pay in the labor market. The gender pay gap in the EU stands at 13.0 % in 2020 and has only seen a minimal shift over the last decade. Roger Brown defined inequality in higher education as income inequality, relying on studies by the OECD (2011), to support his arguments and evidence (Brown, 2017). Women earn, on average, 13.0% less per hour than men (Eurostat, 2021). This is particularly concerning in STEM-related sectors, which have seen much faster growth and higher wages than other sectors (European Parliament, 2015). This means that fewer women in STEM studies can lead to fewer employment opportunities and lower wages in STEM in the labor market. Sectoral segregation has been seen as a major factor influencing wages, with around 24% of the gender pay gap being attributed to women's overrepresentation in lower-paying sectors such as care, health, and education. These highly feminized jobs are often systematically undervalued. The disparity between women's access to higher education and their success has attracted widespread attention, highlighting the invisible barrier between achieving equal opportunity and substantive equality in education (Gidley& Bereded,2010; Fontanini,2020). Substantive equality in higher education requires not only the access to educational opportunities, but also the process and results of education. The econd part of the report Gender Equality, How Global University Performed showed that, in all regions, universities are more likely to focus on providing access and support to women than on measuring their progress and success. As Samoff (1996) elucidated, in order to achieve equality, it is essential to ensure that children [students] are not precluded or discouraged from

pursuing paths that lead to better employment opportunities due to their gender (Samoff, 1996, as cited in Espinoza, 2007, p. 346). Under the background that there is still some distance to achieve gender equality and gender roles are deeply rooted in society, is there any relevant policy in the field of higher education to help women who just enter the field of higher education integrate into the traditional male field and fully release the potential of women? As the lack of study of policies can lead to a significant gap between education research and education policy (Marshall, 1997, p.3). This thesis bring light to the policy on promoting gender equality from the angle of process and success of women in STEM discipline education in higher education institution. How does the current discourse of higher education policy conceptualize gender inclusion? How does current higher education policy promote gender equality in STEM from the perspective of the state, institutions of higher education, and individuals? Are current higher education policies conducive to an inclusive, equitable and quality STEM education environment? How can action to promote gender equality through higher education policies produce tangible results?

The purpose of this thesis is to analyze and compare policies on the macro, meso and micro levels of national, higher education institutions and individuals in two completely different policy contexts, namely Italy and China, and to interview experts on several key issues in order to broaden and bridge the depth of knowledge on gender equality in higher education especially in STEM fields. The thesis is particularly significant because researchers around the world have been discussing the issue of gender equality in higher education in depth and have been communicating with each other on the issue of gender equality in higher education in Italy and elsewhere. However, there are still few exchanges and comparative studies between Italy and China. Therefore, this thesis can be seen as a good opportunity to promote the dialogue between China and the West and promote the dialogue on gender equality in higher education and STEM fields and combine the knowledge deepening of field experts to jointly promote gender equality in higher education and STEM fields.

I. GENDER INEQUALITY IN HIGHER EDUCATION STEM FIELDS: ROOTS AND POLOCY RESEARCH

1.1 Increase in Female Participation in Higher Education and Consistent Gender Imbalance in STEM Fields

Since the University of Bologna was founded in 1088, the early higher education institutions all around the world strictly accepted only males. It was believed that women did not need to attend universities to learn how to take care of their families or do the housework in accordance with their prescribed social role (Carlton, 2023). Only a small number of women were able to enter universities (Fontanini et al., 2021, p. 32). In Italy during the 17th century, Elena Cornaro Piscopia was one of the first women to receive an academic degree from a university, and the first to receive a Doctor of Philosophy degree. She was the daughter of a nobleman in the Republic of Venice, who promoted her education in various ways, and at the age of 19 she was given the title of 'Benedictine Absolved' and went on to study philosophy, theology, Greek, Latin, Hebrew, and Spanish. But when she applied for a degree in theology at the University of Padua, she was strongly opposed by the then Cardinal Gregorio Barbarigo, who believed that allowing women to become doctors, or even to engage in work that came in direct contact with men's bodies, was wrong and disgraceful. In the end, Elena did attend university, but instead received a degree in philosophy in 1678, not theology (Serena & Barbarigo, 1963). The story emphasises the difficulty of women to obtain a degree in higher education institutions at that time. Since the 19th century, starting with the creation of establishments reserved for women like Bedford College in London (UK), Georgia Female College of Macon (USA), Women's College Hospital (Canada), and Bethune College (India), more and more women began to attend higher education institutions. The Georgia Female College (which is now known as Wesleyan College) was chartered in 1836 to award degrees to women and received its first groups of female students in 1839. On 16 July 1840, Catherine Elizabeth Brewer was the first woman to receive a degree from the first college in the world chartered to award degrees to

women since she was the first in line alphabetically to receive one (Synnott, 1995).

Since the beginning of the first wave feminist movement, educational equality has been a strong topic of contention (Goldstein, 1982). In the 1960s and late 1970s, closely related to the political, economic, and cultural development of European countries and American society after the Second World War, the second-wave feminist movement initiated the struggle for the rights and interests of marriage, family, employment, political participation, childbirth, abortion, and social welfare, among other aspects (Brown, 1990). Thanks to the movement for women's rights, the popularisation of compulsory education, and especially the expansion of higher education all around the world in the 19th and 20th centuries, more and more women received education and gained opportunities to enter higher education. Institutions of higher education are still considered by many to be patriarchal institutions, maintaining the patriarchal notions regarding education. Gender segregation widely exists in higher education (WEF, 2022). Even though nine out of ten of the countries in the world have laws against sexual harassment in working life nowadays, almost six out of ten lack adequate laws against sexual harassment in higher education and schools (Tavares & Wodon, 2018). The rise of women to the top of university research and management is demonstrated in the figures of the statistics of European countries (EU, 2021). This can be globally observed, with the number of women in higher education tripling between 1995 and 2018—at a faster rate than male enrolment (UNESCO, 2020a). In most nations since the 1990s, more women than men have finished higher education. In four out of five countries (80%), more women than men graduate from postsecondary education, according to the most recent data available (UNESCO, 2016). In 2019, approximately 51% of 25-34-year-old women held a tertiary degree compared to 39% of men across OECD countries (OECD, 2021).

Women are overrepresented in tertiary education enrolment in 74% of the countries with available data, as well as in all regions except for Central and Southern Asia, where there is parity between the two sexes, and sub-Saharan Africa, where men are overrepresented, with 73 female students enrolled in higher institutions for every 100 males in 2018 (UNESCO, 2020a). Nevertheless, women's higher participation in higher education in the majority of the countries

does not mean that gender equality has been achieved. The World Economic Forum initiated the Global Gender Gap Index in 2006, which assigns scores on a 0-100 scale to indicate the distance to parity (i.e., the percentage of the gender gap that has been closed). The 2022 the Global Gender Gap report, published by the World Economic Forum (WEF), pointed out that the distribution of learners by field in 2019 showed that tertiary education continued to be segregated by gender. With the statistics dividing graduates by fields and gender in OECD countries, the gender gap is most evident in two fields: information and communication technologies which comprised 8.22% of the male graduates and 1.66% of female graduates, and engineering and manufacturing which comprised 24.59% of the male graduates and 6.59% of females (WEF, 2022, P42). According to the Girls Go Circular 2022 report, within the European Union (EU) there is a mere 34% of women among STEM graduates. Globally, the percentage of females studying engineering, manufacturing, construction, or ICT is below 25% in over two-thirds of countries (UNESCO, 2020). In OECD countries only 14% of girls who were top performers in science or mathematics expected to work in science and engineering, compared with 26% of top-performing boys (UNESCO, 2020). The divergence between men and women in choosing majors and career paths is known as gender segregation, and the extent of gender segregation can serve as one of the most important measures for gender equality in higher education (Biemmi, 2015). The report 'Women in higher education: has the female advantage put an end to gender inequalities?', by UNESCO International Institute for Higher Education in Latin America and the Caribbean (IESALC) pointed out the inequalities in STEM enrolment and niche care, women's decrease in number in postgraduate degrees, professoriate, and senior management positions in higher education, and the low labour market income as the limits of the female advantage in HE (IESALC, U., 2021). She Figures 2021, Gender in Research and Innovation Statistics and Indicators, statistic was compiled by the European Union (EU) on monitoring the state of gender equality R&I across Europe and beyond. It provided the data following the chronological journey of women from graduating from doctoral studies to participating in the labour market. Data from 2018 showed that, at the European level, women continue to hold lower positions among doctoral graduates in the narrow STEM fields

of physical sciences (38.4%), mathematics & statistics (32.5%), ICT (20.8%), engineering & engineering Trades (27%), and architecture & construction (37.2%), a small progress since 2015 (EU, 2021a, p. 39). The American Association of University Women (AAUW) reported in 2022 that women make up only 28% of the workforce in STEM (AAUW, 2022). Horizontal segregation involves the concentration of women and men in different sectors (sectoral segregation) and occupations (occupational segregation) (EIGE, 2021a). That horizontal segregation can be seen obviously from higher education to the working place which shows the difficulty in the gender equality progress. Gender diversity, equity, and inclusion gaps persist in STEM fields, with women experiencing less equality and inclusion (Corbett, 2015; Hill et al., 2010).

In addition, the access of women to higher education is only part of the story; it is equally important to ensure that female students (and staff) can remain enrolled (and employed) and take into account that success requires a long-term commitment and a variety of policies and actions. Equality in the higher education process is important. The report 'Gender and education for all: the leap to equality' by UNESCO in 2003, makes distinctions between the terms 'parity' and 'equality'. It holds the view that parity is simply a numerical concept while equality in education presupposes girls and boys are offered the same opportunities to attend school and enjoy teaching methods, curricula, and academic orientation unaffected by gender bias. More broadly, equal learning achievement and subsequent life opportunities for similar qualifications and experience (UNESCO, 2003). There has been criticism on universities only focusing on access but not on the success of female students (Bothwell et al., 2022a). With the access of female students into STEM fields, policies for retaining and empowering female students in these underrepresented fields are required. As an interesting study on 296 women from different German universities in STEM programmes has shown, even for high-achieving female students, stereotypes still undermine their self-concept, so they need to be supported by measures taken to combat these stereotypes. Stereotypes may be one reason that causes girls to attribute their achievements to hard work rather than talent. The results also suggest that support for girls should be indirect, such as increasing girls' contact with female STEM role models. On the

other hand, direct support for girls, especially from their parents, may have a negative impact on female students' self-concept. Activities designed to directly support students can actually backfire and spread stereotypes (Ertl et al., 2017). A study using statistics from Columbia to compare the reading and mathematics performance of STEM disciplines female students showed that the mathematics performance gender gap increased after college (Gomez Soler et al., 2020). Reducing the academic gender gap in mathematics has been shown achievable by more gender-equal societies as measured by the GGI index and the WVS survey (Guiso et al., 2008). The study also expresses the importance of universities in taking measures to foster a more gender-equal environment for the better performance of female students (Gomez Soler et al., 2020). The Times Higher Education (THE) report, 'Gender equality: how the world's universities are performing', highlights that only 69 percent of universities claimed to have enacted policies to track women's graduation rates through the data provided by 776 institutions on their contributions to SDG 5 in 2021. And while most universities claimed to have various policies and services that supported women's progress, most of them were not able to supply relevant evidence (Bothwell et al., 2022b).

Nevertheless, the underrepresentation of females in STEM has brought considerable difficulty for women to fit into STEM disciplines. Schlesinger (1999), held the idea that women being included in the fields of science does not signify that science will adopt a more feminist viewpoint or there will be a change in the culture of the field. Because the association of masculinity with physics has created gendered roles for men and women in physics communities, the study focused on cases from the USA, Canada, and Sweden. Gonsalves et al. (2016), demonstrates that women in the field of physics rejected traditional femininity for a 'female masculinity' in order to be 'one of the boys' and to negotiate the limited possible identities for them as female students in the field. Research on the discipline of masculinity shows that the male-dominated subject 'disciplinary ethos' is traditionally thought to be evaluated by masculine dominance (Gonsalves et al., 2016). The underrepresentation of females in STEM fields forms an environment that is positive for men but unfavourable for women. Female students' self-effectiveness and confidence were influenced by gender stereotypes and

lack of sense of belonging thus influencing the integration and advancement of women in that environment (Ertl et al., 2017; McNally, 2020; Weber, 2012). Research conducted in many countries has shown that women in STEM fields tend to undervalue their own abilities and hold negative attitudes toward their achievements due to the existing stereotypes (Litzler et al., 2014; Fisher et al., 2020; Sobieraj & Krämer, 2019; Ertl et al., 2017). A study of 639 female undergraduates in STEM majors at a large, public Midwestern university in the USA, has found that women's low science performance is influenced by a negative academic climate and the barriers imposed on women to identify themselves as scientists (Settles et al., 2016). As Barbercheck (2001) noted, the stereotype of scientists as objective, rational, and single-minded, is more consistent with typically male gender-normative traits than with female ones. Due to a lack of a female model for scientists, women may find it difficult to fit into an environment viewed as masculine (Heilman, 2001).

The underestimation of STEM self-concept caused by stereotypes has a negative impact on the integration of women in STEM fields. One of the reasons that female students believe their science performance is low is because they believe their gender may impede them from becoming scientists (Settles et al., 2016). Female students have traditionally believed that they were weaker at STEM although, in fact, their performance did not differ from the performance of the male students (MacPhee et al., 2013). Chinese female students show a remarkably low achievement motivation compared with their male colleagues, which is strongly related to traditional social role motivation and it constitutes a major reason for them to drop out of STEM (Yang & Gao, 2019). Faced with a discrepancy between women's social status and STEM social construct status, the low social belonging and self-efficacy felt by women coincided with their underrepresentation in STEM fields (Zacharia et al., 2020; Lewis et al., 2017).

Achieving gender equality requires an approach that 'ensures that girls and boys, women and men, not only access and complete the education cycle, but also gain equal empowerment in and through education' (UNESCO, 2016). In fact, apart from science, mathematics, and computing—where women constituted less than 40% of the PhD graduates—and engineering, manufacturing, and construction, where they accounted for 26% of the PhD graduates, (EU,

2013), there is almost parity between women and men. However, women's increased presence in higher education does not necessarily translate into higher wages or equal pay in the labour market. The gender pay gap in the EU stood at 13.0 % in 2020 and has only seen a minimal shift over the last decade. Women earn, on average, 13.0% less per hour than men (Eurostat, 2021). This is particularly true for STEM-related sectors, which have seen much faster growth and higher wages than other sectors (European Parliament, 2015). This means that fewer women in STEM studies may lead to fewer employment opportunities and lower wages in the labour market, in turn resulting in a lower economic independence for women. Sectoral segregation has been seen as a major factor influencing wages, with around 24% of the gender pay gap being attributed to women's overrepresentation in lower-paying sectors such as care, health, and education. These highly feminised jobs are often systematically undervalued. The disparity between women's access to higher education and their success has garnered widespread attention, highlighting the hidden barriers to achieving higher education rights and gender equality (Gidley & Bereded, 2010; Fontanini et al., 2021).

The goal of United Nations (UN) 2030 Agenda for Sustainable Development is to 'leave no one behind'. In the agenda, education is a fundamental human right and ranked fourth when it came to ensure inclusive and equitable quality education for all people, which is essential for achieving the well-being of society and the fulfilment of the full human potential of both men and women. SDG goal 4.5 pledges, moreover, to 'eliminate gender disparities in education'. It also emphasises in the 'Guide for ensuring inclusion and equity in education' that it is important for countries to ensure inclusion and equity in and through education systems and programmes, building and upgrading education facilities to be child, disability, and gender sensitive for providing safe, non-violent, inclusive, and effective learning environments for all (UNESCO, 2017). Moreover, gender equality is a core principle of the United Nations Universal Declaration of Human Rights and is also the fifth Sustainable Development Goal of the United Nations, which seeks to achieve gender equality and empowerment for all women and girls. Empowering women through education is key to achieving gender equality and sustainable development. Higher education has the potential to create better citizens, empower individuals

to reach their full potential, and lead them to better employment opportunities.

As higher education has become the stepping stone towards employment market (Pelleriaux, 1998), a tertiary degree can significantly reduce unemployment rates and increase the wages of women. In countries with available data, the unemployment rate of women with advanced degrees is typically one-third of those with upper secondary education. The most notable effects of higher education on women's unemployment rates can be seen in European countries such as Estonia, France, Lithuania, Poland, and the United States, where the rate of unemployment among women with higher education is less than half that of women with upper secondary education. Across OECD countries, 25–34-year-old women with tertiary education degrees earn 52% more, on average, than those with an upper secondary education degree (OECD, 2021). Higher education institutions are essential for empowerment and societal transformation, as the education acquired in college may shape the minds of individuals, which in turn may shape and create a more functional society. The 2030 Education Agenda recognises that gender equality requires a way to ensure that girls and boys, women, and men, are not only able to access and complete the education cycle but are equally empowered in and through education. UNESCO believes in the transformative power of education to create a more just, prosperous, and inclusive world for all. The rapid development of higher education in recent decades has brought positive effects on the empowerment of women. In general, gender imbalance in higher education by profession has remained a widespread phenomenon across countries. However, it is interesting to note two characteristics about women in STEM. Research has shown that in countries, such as Finland and Sweden that exhibit greater gender equality and there is higher earning potential, a more significant gender difference in the pursuit of STEM degrees has been witnessed. The situation of gender imbalance in STEM is less pronounced in some developing countries. According to the statistic of World Economic Forum, Finland ranks top in the gender equality countries of the 2023 report of the World Economic Forum. The top nine countries (Iceland, Norway, Finland, New Zealand, Sweden, Germany, Nicaragua, Namibia, and Lithuania) have closed at least 80% of their gap. But regarding gender segregation in tertiary education in ICT science, while the gender gap has just decreased by 20% and 35%, in Finland

and Denmark respectively, in India it has decreased by 95%. While STEM gap has closed by 20% and 35% in tertiary education in Finland and Denmark, in India it has closed by almost 40%. According to the Eurostat data on the graduates in tertiary education (ED5-8) in science, mathematics, computing, engineering, manufacturing, and construction by sex, per 1000 in the population range of 20-29 in 2021, among 1000 women there are 15.9 graduates in STEM, whereas 34.6 male graduates. Only around 31.5% of STEM graduates in 2021 is women in Finland. From the Gender quality Index of EU in 2019, fewer women (8 %) than men (42 %) work in science, technology, engineering, and mathematics (STEM) fields. However, in Iran, 70% of university graduates in STEM are women (Syed & Kreide, 2022). In the United Arab Emirates, Oman, and Saudi Arabia, 60% of STEM graduates are women (Syed & Kreide, 2022). Some research holds the view that in advanced industrial societies, the combination of the ideology of gender essentialism and the value system of self-expression, that is, the combination of cultural belief in fundamental and innate gender differences and a strong emphasis on self-expression and self-actualisation, has created a new system of gender segregation (Charles & Bradley, 2009). In addition, it has been shown that life-quality pressures in less gender-equal countries promote girls' and women's engagement with STEM subjects (Stoet & Geary, 2018). This demonstrates the potential of STEM subjects in empowering women but also shows the difficulties in the intervention of women's choice in society. The second characteristic shown in statistics on women regarding STEM has shown that gender disparity differs in different STEM subjects (Corbett, 2015; Sax & Newhouse, 2018). Women have made substantial gains in many STEM subjects. For example, in America, in 1960, women made up just 8 percent of chemists, but by 2013, women made up 39 percent of the chemical workforce. During that time, the proportion of women in biology has increased from just over a quarter to just over half. The proportion of women in computing, on the other hand, fell from just over a third in 1990 to just over a quarter in 2013, about the same as in 1960. In 1960, women made up less than 1 percent of the workforce in engineering, and by 2013, that number had risen to 12 percent (Corbett, 2015). In fact, engineering has been described as the most gender-segregated non-military profession in the world (Cech et al., 2011; Charles & Bradley, 2009).

The vigorous development of women in STEM fields not only contributes to gender equality but also increases the country's competitiveness and promotes its economic growth. STEM subjects yield higher returns, including higher salaries for fewer years of study. The lack of women in STEM subjects may lead to creative gaps due to the lack of female input in decision-making. The inclusion of gender perspectives is important for the completeness of technological creation (Corbett, 2015; Margolis & Fisher, 2002). Given the role of technology and education in empowerment and the importance in deconstructing the structural obstacle regarding gender equality, many researchers have tried to discern why such discrepancy consistently exists. According to the guide for ensuring inclusion and equity in education compiled by UNESCO, achieving equal quality education for everyone, and achieving inclusion should overcome restrictions on learners' access to learning opportunities, the barriers to participating in the learning process, and the attainment of learning outcomes (UNESCO, 2017). It is worth paying attention to the gender barriers women may face in the process of choosing and learning STEM, and the measures and actions conducive to overcoming these barriers.

1.2 Individual, Institutional, and Social-Cultural Gender Stereotypes Promoting Women's Underrepresentation in STEM

In order to determine what policies to enact, the causes of the problems need to be identified and it is important to understand where the key difficulties lie in solving them. Promoting a world of gender equality and social justice requires a better understanding of how the current gender and social structures were formed, and to cultivate knowledge and wisdom to further comprehend and transform such structures (David, 2016). It is also important to discern how the current gender and social structures are going to affect women in STEM, and what kinds of challenges women may face in the background of the current underrepresentation situation. The current research on influencing factors is trying to answer the following questions: Firstly, if gender factors regarding genius, ability, and interest influence the choice of female student towards STEM disciplines. Secondly, if the traditional gender role division in society influences the choice and performance of women in the STEM majors. Finally, how we can interpret these

reasons to explain the underrepresentation and the feeling of not fitting in, that women experience in STEM, into transformative actions.

In the past, women were not believed to possess the capacity or character necessary for the study of science and engineering. As Voltaire wrote in his Philosophical Dictionary, 'There have been wise women, as well as warriors; but there have never been women inventors'(Voltaire, 1764; Pérez, S. G., 2020). The representation of women in STEM fields is usually reviewed from the perspective of biological and social factors or it is divided into two categories, which are cognitive factors referring to lower mathematical or spatial aptitude in women and noncognitive factors referring to personal preferences and social-emotional considerations (Cheryan & Plaut, 2010; Ceci & Williams, 2007). Throughout years of research, theories about differences in cognitive abilities between men and women have been disproved. Based on a meta-analysis of previous studies, Linn and Hyde (1989) concluded that gender differences in cognitive skills is not significant enough , and the factors that influence women in the direction of their studies can largely be explained by empirical differences and social influence.

The traditional explanation which suggests that the underrepresentation of women in certain fields is due to their lack of interest or ability in those fields has been disproved by a lot of theories. Studies on brain structure and function, as well as hormone regulation, human cognitive development, and human evolution, have not found significant biological differences in the ability of men and women to perform in any science. In addition, psychological, social, and cultural factors have widely been discussed in many fields, such as prejudices, stereotypes, and customs. One of the fundamental arguments for the reason that women continue to be underrepresented in STEM professions is that they do not possess the talent to study STEM. The relationship between talent or intelligence in STEM and women has been widely discussed by scholars. The first question widely debated is whether there are innate differences between men and women in terms of STEM-related aptitude. The second question is whether such aptitude can be accurately measured by standardised tests and whether these tests measure only one type of aptitude. The third question is if this aptitude directly determines success and if aptitude can be changed. Regarding gender and technology, Wajcman (1993) presented a

substantial number of dissertations on the gender of technology and how it came to be formed. The main aptitudes for STEM are mathematic and spatial. In regard to the mathematic aptitude, some researchers believe that its biological basis is rooted in the intersection of cognitive neuropsychology, cognitive psychology, and cognitive development (Dehaene et al., 2006; Feigenson et al., 2004; Newcombe & Huttenlocher, 2000) and found that none of the five studies of systematic development had provided data on gender differences (Spelke, 2005). Linn (2010), conducted a meta-analysis of two major international data to justify that the differences between men and women in math achievement were small, although men had more positive attitudes and influence on mathematics. The average similarity of students is then limited by the large differences between countries. This is also in line with Bandura (1986) as well as Eagly and Wood (1999), who maintain that when women are encouraged to excel and are given the necessary educational tools and relevant female role models, it may have a positive impact on their academic performance. Mathematics word problems in school assessment tests usually have multiple-solving strategies. Girls are more likely to use algebraic rules to solve these problems, while boys are more likely to use spatial reasoning, though this should not be interpreted as a general choice of male and female expertise. Some people resort to the performance on the quantitative portion of the Academic Assessment Test (SAT-M) to answer these questions. On the current test men tend to score higher, leading many psychologists and public commentators to conclude that men have a higher aptitude for math (Cronin, 2005; Pinker, 2002). However, later studies found that different combinations of questions caused shifts in the scores of women and men, and therefore the reliability of the test was called into question. Overall, there is no clear evidence of a gender difference in mathematics. The differences in spatial ability between males and females have been documented by extensive literature, and such differences have been found to correlate with male and female success in science, because mathematical ability may be partly dependent on spatial ability (Casey et.al., 2001). It is also because spatial visualisation is directly related to achievements in many fields of science and technology, including physical sciences, mathematics, computer science, and engineering (Shea, et al., 2001). But it is of special interest whether spatial capabilities directly

determine success and whether these capabilities are modifiable.

Dweck's work demonstrates the power of people's most basic beliefs. There are two main mindsets life can be navigated with: growth and fixed mindsets. Having a growth mindset is essential for success (Dweck, 2006). Steele's research focuses on how stereotypes can lead to a self-fulfilling prophecy. A self-fulfilling prophecy begins as a faulty definition of the situation that triggers a new behaviour that makes the original false conception come true. When talking about self-fulfilling prophecies, people are really talking about what they think of as behaviour. Unknowingly these prophesies are used to ensure that their expectations based on mistakes come true.

According to the 'variability hypothesis', the overrepresentation of men is a result of gender differences, for the theory maintains that greater male diversity leads to relatively more males with exceptional ability. A meta-analysis of 227 studies, covering more than 1.6 million students in first grade and older, excepting college students, has attempted to dispute the 'variability hypothesis', concluding that the gender gap in STEM achievement is small, with a male bias occurring only at the very top of the distribution in STEM subjects. While the STEM majors do not require only the top students, the representation of women is still far less than the percentage of women who perform well in STEM subjects (O'Dea et al., 2018). Also, in this study, O'Dea (2018) pointed out that the gender difference is larger when it comes to non-STEM majors which can make female students feel that there is less competition to study these subjects, and therefore the influence of stereotypes can make women experience threat in STEM fields and not choose them as their majors.

While boys are thought to have better spatial skills than girls, this may also be influenced by their home environment, making boys practice more (Hoffman et.al., 2011). While not all research on this topic confirms gender differences in verbal and spatial skills, researchers generally support that verbal, spatial, and numerical skills—like other cognitive abilities—are flexible and can be significantly improved through early experience (Zhang et.al., 2014; Hoffaman et al., 2011; Reilly et al., 2016).

1.3 Overlapping Factors on Women's Underrepresentation and the Feeling of not Fitting in, in STEM Majors

In addition to the debate about whether women are weaker than men in STEM and all the challenging history of women's participation in STEM, family context and influence (Blickenstaff, 2005; James, 2002; Munk, 2011; Allegrini, 2004), prior educational experience, the particular interests of women themselves which can also be influenced by society, as well as social norm influences are also perceived as possible explanations. Blickenstaff (2005) infers that families with a higher 'science capital' may help female students overcome any cultural pressures aimed at orienting them towards a more traditional cultural influence. According to Wang & Degol, (2017) the widely recognised factors behind women's underrepresentation and feeling of not fitting in include cognitive ability, relative cognitive strengths, occupational interests or preferences, lifestyle values or work-family balance preferences, field-specific ability beliefs, and gender-related stereotypes and biases as six components for lack of women in math-intensive STEM fields in the USA. Stereotyping in education, gender differences in educational and training choices and a lack of female role models are major problems contributing to the low percentage of women graduating in STEM subjects.

Although the presence of women in STEM fields has increased, the following questions arise: what barriers women. as an underrepresented group in STEM fields, face when it comes to achieving excellence in their respective discipline area. Moreover, it is important to answer whether and how the masculine nature of STEM majors, the atmosphere within STEM subjects, the education system and teaching in STEM subjects, form barriers to women's adaptation and sense of belonging in STEM subjects.

The masculine nature of STEM majors has always been widely discussed. People tend to associate masculinity with science, and on this basis, this association has created gender roles in science (Harding, 1986; Keller, 1987; Rosser, 1995). Scientific knowledge is meant to be objective, and a statement that cannot be objectively proven (at least one that cannot be tested by objective verification and refutation) cannot be considered part of scientific knowledge (Reiss & Sprenger, 2014; Miller, 2007; Donini, 2001). Some feminist researchers believe that

STEM disciplines are based on a long-existing disciplinary cognition of rationality, intelligence, and competition, and these structures are related to male roles in history, which has an impact on the construction of women's STEM images (Harding, 1982, 1991; Walkerdine, 1988, 1989). This poses a challenge for women to form a STEM identity by themselves (Walkerdine 1990). Pronin et al. (2004) found that women committed to mathematics tend to use dichotomies to separate themselves from stereotypes around women and mathematics. Archer et al. (2017) believed that young women tended to describe themselves as unfeminine having identified with the discipline of physics. Donini (1991) emphasised that the process of exploring science is presented as a process that needs to suppress subjectivity, emotion, and human relationships. Science and technology are also interpreted as potential instruments of domination over unlimited rights and reality when these important elements that constitute scientific spirit are integrated with masculinity. However, these elements are not compatible with female culture, in particular the culture of 'irrational sensitivity' as a stereotypical characteristic of women. There are studies that have further framed the representation of masculinity in the physics discipline and studies conducted on the link between masculinity and physics (Francis, 2017). The stereotypical masculinity valued in physics students, include technical ability, physical toughness, as well as mechanical and technical skills. (Gonsalves et al., 2016).

To explore issues of inclusion and exclusion in physics communities, Hasse (2002) conducted an ethnographic study of physics classrooms and has come to the conclusion that the understanding of physics as a male activity is also reflected in physics education. Physics learning is characterised by playfulness, creativity, and initiative, which are often attributed to male characteristics. Gonsalves (2016) explored the impact of masculinity on women's integration into disciplines through three case studies from Sweden, Canada, and the United States. The study showed that in disciplines where technical male identity is assumed to be the norm, women not only need to conform to disciplinary male norms, they must also negotiate their place in it, sometimes by being competent in communication. A key finding that emerged in all three case studies was a strong emphasis on physical skills, the ability to use machines, and an emphasis on creativity or tinkering in relation to machine use (Gonsalves et al., 2016).

In both the Swedish (Anne and Cecilia) and the Canadian (Ruby) case studies, as part of their identification with the physics culture, these women reported to have rejected traditional femininity and were seen performing a type of female masculinity instead (Halberstam, 1998). For women in STEM, it is a challenge to recognise their innate abilities. Their fear for STEM majors may influence their performance negatively.

The widely discussed curriculum problem is also one of the factors that contribute to women's lack of sense of belonging in the STEM disciplines. There has always been a debate on the gender of knowledge. Scientists from different research fields have pointed out that the knowledge itself is being gendered by male scientists in the field. The distinction between stamen and pistil is used to incorporate social stratification into botany. The medical field must take into consideration that gender medicine may bring risk to not only female but sometimes male patients. Osteoporosis, for example, was initially thought to be a female disease. The gendered knowledge about different branches of disciplines, which continues to separate females and males into different branches in the same kind of discipline, maintains or even enhances gender disparity.

Sociocultural factors on influencing women's underrepresentation and lack of sense of belonging in STEM majors have a wide scope. They include the influence of society, women's experience in that society, and their family background. It even depends on the country or region they live, which could include the consciousness that forms the identity of that particular society, messages from social media, opinions from family members, or STEM participation of their family members. It may include other factors, such as prior experience while studying in the male-dominated courses in STEM (Miller & Linn, 2015).

Males, on the other hand, are more attracted by the prospect of achieving status in the techno-scientific sphere, given that traditional socio-cultural models and institutions are nearly always represented by male figures. A perception of science as a masculine environment is therefore reinforced in their representations. On the other hand, these elements of strong self-confidence are less present among female students (Henriksen et al., 2015).

In the countries that STEM majors are highly valued, with high status and salary, it is more

challenging for women to have a professional position in that field, since gender equality is mainly about power and the power structure that women can share. While the fields women are involved in are talked about, it is mainly about how the social power structure is impacted. Moreover, there seems to be different gender stereotypes in different social backgrounds that may have influence on women's choices. A study on 350,000 participants in 66 nations showed that the higher enrolment of female to higher education is related to the national weaker gender-science stereotype which is linked to associations connecting science with men more than with women (Miller & Linn, 2015). The cultural background also influences women's choice towards a different major direction in STEM. With countries' expectations for women being different, the choices are also different. Because physics is considered to be more logical and abstract, it is therefore more appropriate for women in Iran, whereas in Spain and Italy, women tend to choose practical work which is directly linked to the work in the lab because they believe theoretical thinking and mathematical thinking is not suitable for them.

The problem of the underrepresentation of women in STEM in higher education is a complicated one that involves overlapping factors from contextual, institutional, individual, and objective perspectives, including the participation of different social entities such as the state, family, educational institutions, and social organisations from the whole spectrum of society, as well as the attention of different disciplines such as sociology, psychology, economics, and pedagogy. Some research seeks to find an explanation for the gender gap from the evidence of differences between males and females. But the individual differences in cognition and motivation are also influenced by broader sociocultural factors. Women's relatively lower participation in male-dominated STEM careers is more likely to be constrained by gender stereotypes imposed from society (Goreth & Vollmer, 2023; Schmader, 2023; Wang & Degol, 2017). However, in order to change the structured inequalities and achieve gender equality in STEM higher education and the STEM workforce, an understanding of the history and context of each country and its school systems is required (Ro et al., 2021).

Based on the data of the third National Survey on Women's Social status (ACWF & NBSC, 2011), Yang & Gao (2021) empirically studies the absence of women in STEM fields in China

from the perspective of motivation regarding achievement and gender socialisation. A one-way analysis of variance was used to compare motivation regarding achievement and gender socialisation in Chinese STEM majors. Multiple linear regression analysis was used to investigate the influence of the two stages of gender socialisation on achievement motivation (Yang & Gao, 2021). The results suggest that this phenomenon occurs because women in STEM majors are less motivated to achieve than men. Gender differences develop gradually in two stages of socialisation. In the social construction of gender roles, lower career expectations from parents and gender stereotypes from culture have a negative impact on women's motivation to achieve. In the process of internalising gender role expectations, traditional gender role attitudes hinder the promotion of female achievement motivation (Yang & Gao, 2021). Therefore, an atmosphere of gender equality should be created to increase female participation in STEM disciplines (Yang & Gao, 2021).

1.4 Strategies Targeting Different Influencing Factors

(a) Female role model strategy

According to the classification of various factors contributing to gender inequality in STEM fields, scholars have proposed different policy recommendations for each factor. To bolster female students' confidence in studying STEM, the need for more female role models, such as peers, mentors, and teachers, has been widely suggested (Cavaglia et al., 2020). A study highlighted the importance of retaining female faculty members as role models in STEM fields, which can be beneficial for female STEM master's student education (J. Yang & Shen, 2020).

(b) Gender-inclusive curriculum strategy

Additionally, in order to reduce the gender gap in STEM, a study found that as other interests increase, female students with STEM career interests are less likely to choose a STEM career, providing a useful perspective in this interest point (Cardador et al., 2021). Moreover, if women are to select engineering programs, engineering needs to be seen as an appropriate field for them. The changes should not merely focus on changing the occupational values (Frehill, 1997). Aronson and others have demonstrated that stereotype threat can be mitigated by educating

students (Johns et al., 2005), convincing them that tests are fair (Good et al., 2003), and exposing students to female role models in mathematics and science (McIntyre et al., 2003, 2005). The most significant differences between male and female students' experiences were found in four factors: their previous experience, their learning methods, the language used in the classroom, and the lack of role models. While strict and objectivist science is only compatible with a narrow range of student gender and racial identities, socially relevant and more constructivist science can produce a wide range of scientists, increasing the possibility of becoming one, and thus paving the way to a more inclusive science curriculum (Mills et al., 2010).

Research has shown that gender differences in Computer Science courses (CS) are related not only to the subject itself, but also to the courses chosen within a CS curriculum. Female college students preferred courses with an emphasis on theoretical CS and social and human aspects, while males preferred the courses focusing on hardware and software engineering (Berdousis & Kordaki, 2019). These may lead to the suggestion that the curriculum include art courses and structured synthesis experiences alongside traditional CS courses (Bares et al., 2018).

It has been shown that when tests are considered to be gender-neutral and when the growth mindset is taken into consideration during studying, the efficiency of female students' performance improves. The strategy that is used in the class to help witness gender inequality and discrimination is useful in reducing gender discrimination and help build a more favourable attitude and a stronger mindset in pursuing a STEM field.

c) Interdisciplinary strategy

With a view to promoting a gender equal learning environment, the idea to break the barriers between different majors is viewed as a constructive one. Since some STEM disciplines are regarded as too masculine, to promote a more inter-disciplinary major can be beneficial in creating a less gendered world. The nature of human science, art, and other majors should be included into STEM majors to improve STEM disciplines. This would constitute a breakthrough strategy for STEAM majors.

(d) Joint effort from different sectors

The Times Higher Education (THE) report, 'Gender equality: how the world's universities are performing, part 2, provides 10 tips for universities on how to combat gender inequality: Universities should create comprehensive solutions that involve the entire university community, focusing not just on women in STEM, introducing more initiatives that focus on women's progress and success, and going beyond national policies and laws. Moreover, they should ensure that policies and services are widely publicised and implemented, regularly review gender equality policies, not be deterred by resistance, regularly collect and analyse gender-disaggregated data, and engage with gender equality experts from other sectors besides higher education (Bothwell et al., 2022a).

(e) Gender sensitive pedagogy

The educational system could introduce teaching materials that are gender-sensitive, and the existence of mechanisms to ensure the inclusion of a gender perspective in syllabi and teaching materials, as well as other ways to include gender perspectives, which may be useful for restructuring the curriculum for gender equality in universities (Mills et al., 2010).

1.5 Key Concepts on Gender Equality in STEM Higher Education Policy

(a) Gender equality

The goal of gender equality is not new, it was established in the 1979 Convention on the 'Elimination of All Forms of Discrimination Against Women'. The Convention presented a document developed by the United Nations Commission on the status of women since its establishment in 1946 in order to disclose all areas in which women are deprived equality with men so as to advance the status of women. The Convention reaffirms the belief of the United Nations regarding fundamental human rights, the dignity and worth of the individual, and the equal rights of men and women. The Universal Declaration of Human Rights declares that all human beings are born free and equal, but also emphasises that the persistent discrimination against women violates the principles of equality of rights and respect for human dignity, which constitutes a major obstacle for women to participate in politics and society on equal terms with

men. In addition, the Convention expands the understanding of the concept of equality and the concept of human rights, further stresses the importance of gender equality and opposes gender discrimination. In addition, it formally recognises the influence of culture and tradition in limiting the enjoyment of fundamental rights by women and aims to enhance the protection of women's human rights.

The preamble of the Convention stresses the awareness that a change in the traditional role of men as well as the role of women in society and in the family is needed in order to achieve full equality between men and women. In article 5, it emphasises that the States parties of the Convention shall take all appropriate measures (a) to modify the social and cultural patterns of conduct of men and women, with a view to achieving the elimination of prejudices as well as customary and other practices which are based on the idea of the inferiority or the superiority of either of the sexes or on stereotyped roles for men and women. Article 10 refers to the fact that States parties shall take all appropriate measures to eliminate discrimination against women in order to ensure them equal rights with men in the field of education and, in particular, to ensure a basis of equality between men and women. (c) The elimination of any stereotyped concept of the roles of men and women at all levels and in all forms of education by encouraging coeducation and other types of education which may help to achieve this aim and, in particular, by the revision of textbooks and school programmes as well as the adaptation of teaching methods. This is the first time that the limits of stereotypes have been clearly defined in an official document, and all articles condemn the cultural discrimination patterns that define the public sphere as the male world and the family sphere as the female world, providing a more comprehensive framework for challenging the sexist forces present in culture so as to promote substantive equality.

The World Declaration on Education for All, adopted in Jomtien, Thailand (1990), sets out an overall vision: universalising access to education for all children, youth, and adults, and promoting equity. The most urgent priority is to ensure access to, and improve the quality of, education for girls and women, and to remove every obstacle that hampers their active participation. All gender stereotyping in education should be eliminated (Degener & Koster-

Dreese, 1995, p. 75). which was also at the core of the 1995 Beijing Declaration and Platform for Action. As Samoff (1996) explains: 'Achieving equality requires ensuring that children [students] are not excluded or discouraged from the tracks that lead to better jobs because they are girls' (Samoff, 1996, p. 346; Espinoza, 2007; Ro et al., 2021, p. 2-3). Being proactive in identifying the barriers that many encounter in accessing educational opportunities and identifying the resources needed to overcome those barriers is an important step towards equality in education.

(b) Gender inclusion

From the 2005 report 'Education for all', the inclusion of education means taking into consideration everyone's needs, especially the individuals' who occupy a marginalised place in society. The key for education has been expanded to include education for all without exceptions. In the 2020 Global Education Monitor Report, the meaning of equality, equity, and inclusion were defined: equality can be viewed as a state of affairs (what), a result that can be observed in inputs, outputs or outcomes; equity is a process (how), whose actions aim at ensuring equality; inclusion is defined as, first and foremost, a process relating to actions that embrace diversity and build a sense of belonging, rooted in the belief that every person has value and potential and should therefore be respected (UNESCO, 2021, P2-3).

In this research, the definition of gender inclusion is the same as the one clarified in the report. Inclusion is complicated, it can involve both the means and the end, the leading way and the result, which is difficult to measure and define. Gender inclusion in education has potential to promote gender equality. The 2020 Global Education Monitoring Report investigated how inclusion in education can advance gender equality in and through education. The report goes beyond gender equality in participation and completion rates at different levels of education to examine sources of gender discrimination in education, such as teaching materials, water and sanitation, laws and policies, as well as the impact of other adverse discrimination, such as the intersection of poverty, geography, race, disability, and gender on women's education.

Inclusion is seen as a process of addressing and responding to the diversity of needs of all children, youth, and adults through increasing participation in learning, cultures, and

communities, and reducing and eliminating exclusion within and from education. It involves changes and modifications in content, approaches, structures, and strategies, with a common vision that covers all children of the appropriate age range and a conviction that it is the responsibility of the regular system to educate all children (UNESCO, 2005).

Most conceptual frameworks incorporate two important components: the cognitive development of the learner on the one hand, and the role of education in promoting values and attitudes of responsible citizenship, as well as creative and emotional development, on the other.

(c) Gender stereotypes

Gender stereotyping is viewed as the obstacle that prevents girls from engaging in science, and boys from care fields. Based on the psychological theory of gender stereotypes, people associate men and women with certain skills or traits due to their stereotyped impression of the social image of men and women engaged in certain occupations. Gender stereotypes formed by these gender biases result in gender segregation in STEM fields. Women must deal with a lifelong questioning of their ability in science and mathematics and their commitment to a career, which gender stereotyping has resulted in.

The research aimed to discover what kind of gender stereotypes exist in STEM and the way these gender stereotypes tend to influence the behaviour of women in STEM. There are different kinds of gender stereotypes. The stereotype that associated male and STEM together, excluding the female, is the most prevalent gender stereotype in STEM. Miller & Linn (2015) conducted research to discover the influence between gender stereotyping towards science and the representation of females in STEM, dividing it into explicit gender stereotype and implicit gender stereotype to make a more accurate measurement regarding gender stereotypes. The questions set to measure explicit gender stereotypes constituted in asking participants to rate how much they associate science with males or females on a 5-point or 7-point scale and the same question was repeated by replacing 'science' with 'liberal arts' as a measurement in the alternate academic domain. While ideas were being formed in this experiment, questions concerning gender stereotypes regarding science-related abilities and interests, such as 'Do you think males or females are more interested in science' were not asked because this question

aimed at solving the gender stereotype of general connection between science and male but not gender stereotype with science related attributes. The measurement of implicit gender stereotype was facilitated by using a computerised task to test the reaction time of people towards the relationships between males and science words, and female and liberal arts words, thus showing the extent of stereotypes. In this experiment, stereotypes were difficult to measure since there are different kinds of STEM related gender stereotypes. However, in this study, the word gender stereotype in STEM in higher education can be viewed as a basket of gender stereotypes which contained all kinds of gender stereotypes that exist.

Studies on the impact of gender stereotype on female students' self-concept showed that even though the female students participating in the study received good grades in STEM, the existing gender stereotypes still corrupted their self-concept when it came to attributing girls' achievements to diligence instead of talent (Ertl, et al., 2017).

(d) Gender social roles

Based on the social binary gender division, society and socially defined patterns of behaviour are built on the male and female division. The gender ideology studied by Paechter (2007), suggested that the ways in which people succeed are limited by the masculinities and femininities acceptable in a community. Scholars studying the theory of social role construction, generally believe that socially constructed gender roles tend to affect people's gender cognition and affect individual choices. Paechter (2007) also makes a distinction between masculinity and femininity, defining the collective ideal of what it means to be male or female in a particular local context, and the way people treat boys or girls, men or women.

Kelly (1987) places the focus on the gender image of science which makes it difficult for females to form and sustain a science career when men are encouraged to do so. David A. Hollinger mentioned in the foreword of *Reflections on Gender and Science* that Sinclair Lewis's brilliant work *Arrowsmith,* an important American novel, gives a picture of the role of the scientist which is defined by both the scientific and the literary authorities of the time (Keller, 1987).

However, education plays an important role in social construction, which indicates that gender

roles can be reconstructed through learning process. Education, as a favourable means to uphold human rights, plays a positive role in the reconstruction of social gender equality patterns.

(e) Gender bias

While explicit gender bias, also called self-reported bias, is decreasing, implicit or unconscious gender bias is still pervasive (Corbett & Hill, 2015). This type of bias is usually believed to affect individual behavior, but it can also shape institutional practices and structures (Handelsman & Sakraney, 2015). The term implicit social cognition was introduced by Greenwald and Banerjee, to describe the cognitive processes that occur outside conscious awareness in relation to psychosocial structures (attitudes, stereotypes, and self-concepts).

Residual negative gender norms in society produce gender bias in education, affecting teachers' attitudes, subject and career choices, and affecting women's opportunities in later life (UNESCO, 2020). Social psychologists believe that the majority of discriminatory behaviour is a manifestation of implicit bias, stemming from gender schemata or untested ideas people hold about gender roles (Valian, 1998; MR & AG, 1995). Sexism and the threat of masculinity in STEM areas are manifested through the reluctance to accept evidence of gender bias, resistance to gender diversity initiatives in STEM, and exclusionary attitudes towards women. Biases are also evident through the explicit endorsement of stereotypes about women in STEM (Blackburn, 2017). The fundamental norms and values (implicit and explicit) that are deeply gendered in academia are also addressed (Bencivenga & Drew, 2021). Formal and informal norms and regulations, including subtle ones such as ostracism, neglect, and social exclusion, serve to reinforce and perpetuate gendered structures of privilege and marginalisation at different levels of the academic hierarchy (Clavero & Galligan, 2021).

1.6 Obstacles to Gender Equality Policies in STEM in Higher Education

Ideological obstacles constitute the different ideological groups that may have contrasting views on the goals and approaches of specific policies. These differences can lead to debates, disagreements, and challenges in formulating and implementing policies that are widely accepted. The tensions between policy and practice contains the need of policies to be defined

clearly and in operational terms, that involves transformative ideas from feminist literature. How to better conduct policy narrative, integrate the purpose and means of policy formulation with theories, and promote the understanding, support, and promotion of policies is an important topic to be considered in policy formulation.

The change in the culture of science to be inclusive is an effective way to deal with gender bias in science. But cultural change requires the majority to accept and act on the idea that gender bias exists. However, research has shown that men, especially in STEM fields, do not recognise the existence of gender bias in science, which is a major obstacle for promoting cultural change in that field (Handley et al., 2015). Studies have shown that in many cases, individuals seem to reject gender mainstreaming policies and consider gender inequality to be a non-issue (Connell 2006), or they are unaware of the ways to implement these policies (Lombardo & Mergaert, 2013; Mergaert & Lombardo, 2017).

Feminist policies often face resistance from individuals and groups and may be opposed by those who believe that gender equality policies undermine traditional values or privileges and threaten the existing power structures and norms. Insights from feminist sociologists suggest that, to change universities to reflect institutional diversity and the realities of contemporary faculty life, it may be more useful to identify a set of commitments and principles that inform policy and practice, rather than to specify actions that support cultural change.

A certain disappointment regarding the results of gender equality policies may be due to both inadequate or unfinished design, as well as to the difficulties encountered in their application in university institutions with gender-biased cultures and practices (Fontanini et al., 2021 p. 128).

There is still an equality premise that formally forces institutions to adapt and incorporate gender policies; however, resistance, slow development, lack of will and funds, and the patriarchal model have an excessive weight even in university structures (Fontanini et al., 2021). Patriarchy creates obstacles to feminist policies by upholding traditional gender roles, norms, and power structures that impede the efforts to achieve gender equality.

According to feminist institutionalism theory, institutions are formal and informal gender

structures and norms that can reproduce or offset gender inequality (Chappell, 2006). They form a regime in the battlefield of norms (Kenny & Mackay, 2009), they do not constitute a single resistance to gender, but a place where power relations are generated and gender inequality is combatted (Dahl& Kantola, 2005). Within an institution, the power and norms of hegemonic groups not only promote specific (male) behaviours, but also impede or oppose the changes facilitated by gender initiatives such as gender mainstreaming (Kenny, 2011; Mackay, 2011). Morley (2007) criticised Britain's Athena SWAN policy, which was mainly driven by economic needs and focused on the equal inclusion of female social groups in higher education institutions dominated by white males, instead of focusing on reducing inequalities in education and society.

1.7 Disputes in STEM Higher Education Gender Equality Policies

Studies in Europe have shown that by promoting more women and girls into STEM fields, the EU could increase GDP per capita to 3% by 2050, raising the EU's GDP by 820 billion euros (European Institute for Gender Equality, 2022b), and generating 16 billion euros annually (Girls Go Circular 2022). However, when the study's authors examined each country's overall life satisfaction rating, which measures economic opportunity and daily challenges, they found that countries with gender equality had higher life satisfaction. Life satisfaction seemed to explain the 35 percent of the difference between gender equality and women's participation in STEM, with women choosing their preferred major (Stoet & Geary, 2018).

This correlation echoes research showing that the sexes are more segregated in areas of learning in more economically developed regions. Following this logic, a paradox emerges that if the primary goal is equal representation of women in STEM fields, society needs to provide fewer choices to women and eliminate social programmes that provide economic security, such as in Turkey and the United Arab Emirates, otherwise there needs to be rejection of the simplistic reasoning that tries to measure social value in monetary terms and insist that a truly just society is one in which individuals are free to make their own choices (Mary, 2018).

This kind of logic is questioned by its excessive focus on economic attainment and ignoring human well-being itself since there is risk when humans are regarded as merely tools for the

economy. The cultural environment of the modern economic market, education, and economy have contributed to that connection. Education has a fundamental impact on wealth distribution by influencing the way wealth distribution is attained. The idea of equal gender opportunities in the STEM field need to be the focus of education policy. Morley (2007) claimed that the institutional change is based on the instinct of economic benefit which is not conducive to the direction of promoting gender equality in education and society.

This brings attention to the question of the legitimacy of the policy: how we may be able to promote economic development through investment for women in order to promote the vigorous development of female STEM, solicit male support, and gain male recognition of its importance. The policies that promote the development of STEM for women are, in essence, policies that promote the realisation of women's human rights. In the context of economic and human developments, policy makers must focus on how to integrate women's participation in STEM fields with the issues of well-being, sustainable development, and the promotion of women's human rights and equality, so that the importance of this issue and their universal identity can be strengthened. Policies should be justified in the context of fundamental human rights concerns and should demonstrate the justification and usefulness of their means, as well as the universal benefits and sustainability of their results.

Gender equality in STEM fields in higher education is often considered a social issue. Some scholars believe that although gender gap in higher education is still prominent in several countries, higher education is not the root cause of the phenomenon; rather, it is a social problem which had been reflected in the field of education before higher education. According to the Flemish Education Council, even if this problem can be changed from the education perspective, it has been pointed out that there is not much to be done from an equational standpoint beyond studying choice guidance. This signifies that when formulating policies for equal participation in different disciplines of higher education, the educational policy goals should not be solely market-oriented, relying on an economic framework that focuses too much on equal participation in STEM and not enough on personal development and critical-creative integration in society. Instead, the focus should be on the potential of human beings; equal

participation can be the result of study choice guidance (Fontanini et al., 2021).

However, education measures are important to change attitudes, break down cultural norms and prejudices that underlie discrimination, and empower rights holders. When socialisation theories are used to explain segregation, and preferences are developed during childhood, a report by the Swedish government (SOU, 2011:1, 187) suggested that HE institutions can do little to affect segregation. Powell (2022) provided research on mechanisms at work within university programmes that reinforce or potentially counter gender-segregation in the process of higher education as justification that it is beneficial to make changes in universities. Universities hold a special position in gender equality; they can strive to give female students equal opportunities in the process of application, admission, and completion. They can educate students on gender equality and teach curricula that treat female students equally (Bothwell,et al., 2022a).

Some countries have developed gender sensitivity training policies aimed at helping teachers and staff to recognise and address gender-based discrimination and harassment in higher education through training. Gender-sensitive teaching promotes the intentional development of inclusive practices to support and foster gender equality and diversity in the classroom. It is a pedagogical approach that examines the links between learning processes and institutionalised power differences and is based on gender-affirming practices, particularly those embodied in the core tenets of feminist pedagogy. Gender sensitive training policies refer to the education methods conducive to the attainment of these goals. The EU-funded Baltic Gender Project, which involves partners from eight scientific institutions in Germany, Estonia, Lithuania, Sweden, and Finland, seeks to develop gender-sensitive teaching methods in marine science and technology and to promote the use of gender-sensitive STEM teaching and gender-sensitive marine research. In its gender-sensitive approach to teaching, the project emphasises the integration of gender into the curriculum and gender-sensitive teaching environments (EU, 2021).

As principle 10 of Athena SWAN stated, all individuals have identities shaped by several different factors (Crimmins, 2019). The intersecting identities and experiences of gender with

age, disability, gender, race, religion, and sexuality should be considered in the initiatives for gender equality (ECU, 2018). According to the theory of intersectionality, gender segregation constitutes an oppressive environment formed by intersecting factors, such as class, race, and gender (Collins et al., 2009; Gillborn, 2015). It is necessary to build an inclusive overall environment to promote the full realisation of human rights in vulnerable groups that cannot be affected by various factors (Craissati et al., 2007; Peters, 2004).

Some studies showed that intersectionality is positive for bringing an inclusive environment which is beneficial to everyone. The most recent SFI Strategy of 2025 (Science Foundation Ireland, 2015) focuses on three key areas; namely, excellent research, top talent, and tangible benefits. Within the 'top talent' area, there is an ongoing commitment to gender equality, captured within the expanded equality, diversity, and inclusion umbrella. To bring diversity, inclusion, and equality to everyone is the objective of several policies. But when it comes to the policies on gender equality and the policies on gender diversity and inclusion, how to properly design the policy to fulfil all the objectives can prove to be a challenge. When the theory of respecting and taking into account everyone's diversity as being more conducive to the realisation of gender equality gets more support, the policy will tend to focus on diversity inclusion and equality policy and take gender equality as one of its realisation links. However, it should be noted that when the logic of policies no longer follows the path of promoting gender equality constructed by feminist theories, such as resource allocation and power distribution, which are the concerns of gender equality, the realisation of gender equality is at risk of being ignored. Nevertheless, when the diversity issue is not the main concern of the policy, the realisation of gender equality is the main policy purpose, and the diversity theory needs to be the necessary consideration for the realisation of gender equality and the favourable driving force for the realisation of gender equality. How to regulate the inevitable cross-over factors in the gender equality policy is another issue worth thinking about as well as how to determine the core concerns of the policy and how to regulate the cross-cutting factors on this basis are the premise of policy formulation.

In the European context, with the widespread application of gender mainstreaming policies, the

issue of gender equality in the science profession is often promoted as a sub-proposition of gender mainstreaming policies. The concept of gender mainstreaming was formally proclaimed at the Fourth World Conference on Women held in Beijing in 1995, also known as special feminism, emphasising that the United Nations and other organisations must strengthen feminist development policies and plans with the full and effective participation of women in order to promote equal rights for both men and women. However, the gender mainstreaming policy itself has its limitations, and how to properly formulate and implement gender equality in the scientific community under the gender mainstreaming policy is also controversial.

Gender mainstreaming policy is the main objective of the institutionalised aspect of feminism. It affects the change of political rhetoric and helps people to realise the significance of promoting the realisation of gender equality in the traditional gender binary society in social norms. However, promoting gender mainstreaming in policies may make gender equality become a mere formality, and the frequent use of gender-neutral language may also lead to the neglect of gender power relations (David, 2016). Studies have shown that the prevalence of local representations and discourses on gender equality and gender mainstreaming may weaken the structural approach that was originally central to gender equality policies, thus making the policy less transformative (Cavaghan, 2017, p. 46). Research suggests that, in fact, gender mainstreaming policies are often insensitive to core feminist issues of power, class, and difference (Biglia et al., 2015). However, some studies maintain that since the gender equality mainstreaming policy was introduced, the concept of gender equality was relatively vague, and such ambiguity affected the implementation of gender equality policy (Cavaghan, 2017, p. 19). Anagnostou (2022) argued that, upon analysis of the policies on the localisation of gender mainstreaming policies in Greece, Cyprus, Romania, Italy, and Serbia, there has been a lack of coherent discourse in the policies on promoting gender equality and gender mainstreaming in research and innovation in these countries. Inadequate development to uncover structural barriers and implicit bias is a major obstacle to the potential of gender equality policies.

AQU Catalunya proposes a framework to include gender mainstreaming as a key aspect of education quality measurement, which may ensure that the content on engineering design

considers the needs of females as an assessment indicator that influences the design and delivery of science and technology courses through the re-gendering of curriculum (Catalunya, A. Q. U., 2019; Verge, 2021). At the national policy level, it is essential to provide official legislation or incentives to pursue sustained implementation of global economic strategies to garner support from top management, research institutions, universities, and to foster a willingness to develop effective action plans. Without such support, policies and strategies may become nothing more than bureaucratic tasks (Anagnostou, 2022). A 2015 paper for the European Parliament's Committee on Employment and Social Affairs reveals that Europe has three primary strategies for promoting STEM studies and careers in Europe: revising curricula and teaching methods, providing professional development for teachers, and guiding young people towards STEM fields (Palmen, 2015). These policies are in line with gender mainstreaming initiatives and may help to create inclusive environments in higher education institutions through teachers, teaching materials, and course content.

This policy was designed from a structural change perspective, aiming to bring about a broader societal transformation. How to include gender mainstreaming in higher education in the gender mainstreaming agenda, whether the content of gender mainstreaming in STEM fields is more effective, and whether the content of gender equality in STEM fields should get attention in a separate policy form, are all policy questions worth thinking about.

To bring gender equality into STEM higher education, there is a wide debate about whether to approach the issue from an individual or an institutional perspective. Casula (2016) suggested that women's empowerment is best understood as a social, rather than an individual process, after analysing the initiatives of Microsoft Italy to boost female students' self-confidence and motivation. A study involving video intervention for diversity is STEM-VIDS, which included two sets of video narratives which have been negatively affected by gender bias in the sciences. Moreover, there were expert videos with a psychology professor being interviewed on gender bias that were found to be effective in increasing awareness regarding bias without impairing the self-efficacy of the bias. However, it has been shown that this kind of intervention can have a negative effect on the sense of belonging of the female interviewer in this field (Moss-Racusin,

et al., 2018; Hennes et al., 2018; Pietri et al., 2019). These experiments have raised the awareness on the importance of back-up supported socio-cultural context which can support the well-designed individual initiatives. It can be found from the research that neither the individual policy nor the systematic reform policy has the effect of independent reform. Only the appropriate combination of the individual policy and the systematic policy can be effective. At the same time, substantial literature doubts that the current system solidifies the advantages of patriarchy, while women's choices are actually made under the extensive influence of society and family.

Initiatives on how to make institutional changes in STEM higher education are widely implemented and discussed. However, initiatives to promote gender equality in STEM higher education often fail to challenge gendered norms and bring about deep-systemic change. Many papers have attempted to provide solutions to the gap between intervention and implementation. Powell (2018) tried to identify the resistance to gender equality (GE) projects by examining the reactions of university staff in different positions and concluded that institutional actions should begin with collaboration to bring consensus to the issue.

The analysis of the Athena SWAN showed that, when it attempted to promote an institutional change in higher education institutions, the policies focused on making women equally involved in higher education institutions with a majority of white men and with financial benefits which pushed towards change, but not in the direction of reducing the gender inequality in education and society (Morley 2007).

The formation of inclusive environment in colleges and universities is closely related to the sex ratio in these colleges and universities. However, some experts are opposed to changing the gender ratio through educational policies, believing that such policy aims do not accord with the fundamental purpose of education. Moreover, it is necessary to increase the number of female role models through policies to promote the balance of the ratio of male and female employees or professors in colleges, to promote self-confidence, a feeling of belonging in women, and an increase in women's self-concept. One policy often adopted to achieve proportion equality is 'gender equality quotas'. It is an important way to promote gender ratio

by stipulating the proportion of women in higher education institutions or adopting the policy of giving priority to women in the same situation in the selection of professors. The meritocracy has long been a guiding principle in academia. Some studies hold the view that meritocracy can increase inequalities, in the sense that the best and most hard-working should be rewarded and the failure of women to be included should be attributed to their inadequacy, therefore the aim of gender equality may be deemed unnecessary (Darnon, 2018; McCoy, 2007; Lawton, 2000). However, feminist studies have found that the practice of meritocracy cannot reflect the gendered norms that influence who is considered merited and who deserves to work in the discipline (Powell, 2016). Studies have shown that gender bias exists in every step of women towards becoming professors. One of the key factors in career development is productivity, which is often measured by the number of academic papers published. It has long been thought that female scientists and engineers are less productive than men because they publish fewer papers. However, there is evidence suggesting that productivity reflects rank in the academic hierarchy and the resources that those positions provide, rather than an independent characteristic of the individual. Male and female scientists and engineers tend to be equally productive when academic status, available resources, type of institution, and other personal and institutional factors are held constant. Other evidence suggests that the average impact of female publications is greater than that of male publications (National Academy of Sciences, 2007, p. 113). In the process of peer review, gender influenced the evaluation towards achievement and the opportunities and rewards that people receive. One research on peer review scores on application for postdoctoral fellowship in Sweden showed that women received systematically lower competence ranking compared with men (Wenneras & Wold, 2010). In fact, it seems that women must be more than twice as productive as men to be considered equally competent (National Academy of Sciences, 2007, p. 143). Stereotypes actually form obstacles to the realization of gender equality and also become one of the factors affecting the fairness of elite rules.

Many studies have begun to discuss how to balance gender equality and meritocracy (Park, 2020; Powell, 2022; Blair-Loy & Cech, 2022). Park (2020) suggested that meritocracy and

equality are two co-existing important principles of academic practice; equality in academia should be viewed as a project aimed at equality of individuals, not organizations, and the focus should be on governance, not equality, and making equality separate from permanent organizations. Gender quotas for female academics in higher education are a widely discussed way to improve women's participation, which can be a challenge to the meritocracy of higher education institutions. 'Gender neutrality' in STEM refers to arguments that deny, overlook, or explain away women's underrepresentation in male-dominated areas as symptomatic of women's own failings, rather than acknowledging systematic, institutional, and cultural inequalities (Jack, 2009). However, some research has shown that the impact of gender quotas can be limited and slow acting in underrepresented areas, and the risks and unfairness should be controlled (Park, 2020; Coe, 2019).

Feminists advocate that girls and boys are equal in their approach to science, and that obstacles that exist outside of science are the reason girls in fact participate in science to a lesser extent than boys (Sinnes & Løken, 2014). Difference feminists hold the idea that these 'feminine' characteristics should be recognized and acknowledged when studying science (Nash, 2000). This ideology difference can be recognized in the statement of gender equality policies.

II. METHODOLOGY AND METHODS

2.1 Research Aims and Questions

2.1.1 Research Aims

With the descriptive and exploratory research approach, the main aim of the study is to critically analyze the policies employed to promote a gender inclusive, equitable and quality education in STEM in the higher education period in Italy and China and explore the directions for enhancing the policies.

The following two specific aims are included:

Firstly, to understand the gender equality policies in STEM HE in Italy and China. With the specific background of the researcher come from China and study in Italy, to describe the historical process of political and social background under the two cultures, to serve as the context for the comparison of policies for promoting gender equality in STEM higher education. Then the aim is to comprehend the current gender equality policies in STEM higher education in Italy and China, in order to determine recent advances, challenges and gaps for promoting a gender inclusive, equitable and quality education in STEM in higher education.

Secondly, to explore the priority aspect of gender equality policy in STEM higher education from the three dimensions of individuals(micro), higher education institutions(meso), and the country(macro).

2.1.2 Research Questions

Based on the research aims, there have four research questions:

● What are the characteristics and positive actions of policies that effectively promote gender equality in STEM higher education?

● What are the commonalities and differences of priority of current policy in Italy and China to promote gender equality in STEM in HE?

● On the historical background of Italy and China and the situation of gender equality in

STEM HE in Italy and China, what can we learn from the different meanings, implications and outcomes of policies in Italy and China to provide a conducive inclusive, equitable and quality STEM education environment?

● What kind of polices can be benefit in promoting gender equality in STEM from the perspective of the state, institutions of higher education, and individuals?

2.2 Research Methodology and Methods

2.2.1 Methodological Considerations

Stemmed from a wish to understand how country from different cultural, economic and historical background fulfilled State obligations to protect education right to deal with the gender gap in STEM in higher education, the study embraced a qualitative research method. This approach describes more cultural contextualization, historicity, more generalizable to real life settings (Erickson & Gutierrez, 2002; Donmoyer, 2012), in order to emphasizing the deconstruction of the problem differently contextualization. It's worthy to explore how different countries deal with this on the policies under different context，through the process of "making the strange familiar, and the familiar strange" (Harker, 1982, p. 43; Bray, 2004, p. 250), to heighten the contrasts and reveals similarities. In this research, two case studies (Yin，2014)，

Italy and China are compared (Bray et al.，2014; Bray & Thomas，1995) focused on the priority of the gender equality policies in STEM HE.　To supplement and deepen the analysis of the issues, expert interviews were also conducted on policy questions concentrating on promoting inclusive and equitable quality STEM higher education.

Using a comparative framework(Bray &Thomas，1995), the comparative policy analysis focuses on three dimensions: geographical location (Europe and Asia: Italy and China); non-geographic population groups (women in STEM HE) and Priority aspects and challenges of gender equality policy discourse. The formulation and implementation of policies are based on the existing problems of the country and are highly contextualized and its implementation even

more context-dependent under the social background of the country (Bray et, al., 2014). When studying cultures that are different from the original culture, it's necessarily end up seeing the original worldview in a new light. The social background of policy formulation will be presented from the historical changes of policy process, regional characteristics, and a list of relevant policies, etc. Women in STEM higher education in Italy and China will be introduced from the presence of women in higher education in Italy and China and the presence of women in science, especially the leakage of STEM pipelines. The aim is to understand and analyze the reasons for the common and different aspects of policy focus of gender equality policies in STEM higher education in Italy and China, as well as the implications. The policy data used for the comparative analysis came from official recourse data-based of Italy and the European Union, which has influence on Italy, and China. Textual analysis of gender equality policies in STEM higher education in Italy and China from official policy documents (sources include programmes, plans, official advice, and other public political tools) are implemented with thematic analysis methods (Braun & Clarke, 2006) to deepen the deconstruction and understanding of policy directions and contents. For critical analysis, we draw attention on the Analysis Framework for Mapping Inclusive Education Policies (EASNIED, 2018), and applies these two theories as heuristic tools to STEM gender equality education. The aim is to understand the direction of policy measures taken in Italy and China to promote gender equality in STEM, and to reflect on the gaps and challenges in ensuring women's right to education, promoting women's educational opportunities and building a gender-inclusive environment. Whether national Policies provide a clear vision and concept for Inclusive Education to improve educational opportunities for all learners can be analyzed through the policy issues mapped by the Analysis Framework for Mapping Inclusive Education Policies.

Considering that the goal of this paper is to analyze whether the policy is committed to improving women's education opportunities in STEM, this paper referenced from apping questions for policy of Analysis Framework for Mapping Inclusive Education Policies (EASNIED, 2018), and references five issues focused on "vision", "implementation", "vulnerability", "framework" and "needs" for thematic analysis (Braun & Clarke, 2006) of the

policy. The explanation of these concerns can enrich our understanding and knowledge to promote STEM HE inclusiveness and equality.

As Bardach & Patashnik (2016) concerned "In policy research, almost all likely sources of information, data, and ideas fall into two general types: documents and people" (p. 87). Using only policy analysis alone will not have produced enough depth in the topic. Using a blended methodology comparative   policy analysis(Braun & Clarke, 2006; Bray &Thomas，1995) together with expert interview (Meuser & Nagel ,2009) focused on specific questions enables a rich understanding of the policy on gender equality in STEM in higher education. Meuser and Nagel (2009) describe the expert interview as a qualitative interview based on a topical guide, focusing on the knowledge of the expert, which is broadly characterized as specific knowledge in a certain field of action. With the purpose to identify the directions for the gender equality policy in STEM, the thematic analysis methods (Braun & Clarke, 2006) is used in the expert interview to identify the key concerned in the constructing of gender-inclusive and equitable STEM HE environment. Drawing on both comparative policy analysis and insights from expert interviews, this paper delves into the observations of gender equality policies within the STEM field.

Table 1. Overview of the Sample & Methods of Data Collection Used

	SAMPLES	METHODS
GOVERNMENT LEVEL	13 Programmes, plans, official advice, and other public political tools ,8 from Italy, 5 from China	Documentary analysis Comparative analysis
EXPERT LEVEL	5 Experts	4 Semi-structured interviews with expert 1 Documentary answer

2.2.2 Policy Analysis

Concerned what is policy，Ball (1993) considers "policy as both text and discourse". The texts are constructed under the compromises at various stages (at points of initial influence, in the micropolitics of legislative formulation, in the parliamentary process and in the politics and

micropolitics of interest group articulation (Ball, 1993). The policies can be viewed as representations which are encoded (via struggles, compromises, authoritative public interpretations, and reinterpretations) and decoded (via actors' interpretations and meanings in relation to their history, experiences, skills, resources, and context).

The scope of policy analysis, which ranges from an interest in the workings of the state to a focus on practical contexts and policy distribution outcomes, also precludes the success of a single theoretical explanation (Ball, 1993). When analysis is a complex social problem like policy, two or more theory together can be a good idea (Ball,1993). Ozga (1990, p 359) believed that it is crucial for policy analysis to "bring together structural, macro-level analysis of education systems and education policies and micro level investigation, especially that which takes people's perception and experiences into account". The analysis of policies should combine the document analysis from a comparative perspective and the expert interview together to dig into all the explicit and implicit information.

Policy is a process fraught with choices and involves adopting certain courses of action while discarding others (Yang, 2014). The aim of policy analysis in this research is to analysis the content of text and figure out the priority of the STEM GE policy and the policy gap towards a gender inclusive and equitable higher education environment.

2.2.3 Comparative Framework: Bray and Thomas Cube

The comparative analysis of policies needs to deepen the cognition of multiple aspects with multi-level basic principles to avoid superficial or simplistic results (Barros, 2009; Dale and Robertson, 2009). Bray and Thomas cube(Bray &Thomas，1995) is a multilevel comparing framework constructed by Mark Bray and R. Murray Thomas in 1995 argue that the comparative education between countries is always not complete and balanced because it fails to consider significant different concepts of world regions/continents, countries, states/provinces, districts, schools, classrooms, and individuals. The multilevel and more complete comparative framework proposed by authors is meaningful to the study of the policy issues of gender equality in higher education in STEM fields. Gender equality in higher

education in STEM fields is characterized by multiple levels and perspectives. For example, due to the uneven economic development of different regions in China, and the gap between the economic level of southern and northern Italy, students from different regions are affected by different economic backgrounds, educational levels of parents, social stereotypes in the region, economic factors and other factors when choosing higher education majors and employment. For example, the gender gap is also different in subdivided fields, such as mathematics, physics, biology, chemistry, engineering, and other related fields. Due to the different policy directions of different countries, such as different education systems, social development levels, and national development directions, countries also have different policy priorities in promoting gender equality in STEM fields. In the process of comparison, the one size fits all and world standards that often exist in the comparison of educational policies are inevitably not applicable. However, we still need to explore some different solutions to the existing implicit discrimination through comparison, through the process of making the familiar become strange and making the strange become familiar.

On the one hand, the difference in the comparison of policies depends on the difference in the purpose of research, on the other hand, the difference in the definition of policies. These comparisons take diverse forms, partly because the purposes of the stakeholders are different, and partly because the underlying conceptions of what constitutes policy vary greatly.

The research framework of Bray and Thomas cube (1995) aims at the comparison of subdivisions under each level which is often neglected. In the research on gender equality in STEM, experts also try to figure out the problem under all disciplines and subjects, to locate the gender inequality problem in specific area. The specific dimensions including STEM students at different academic levels, students in different STEM majors, and the family background of female students will also have an impact on their performance in STEM fields. For example, whether the student is a first-generation female college student in her family, whether the girl comes from a place with a good economy or a bad economy, if the female student's family member studied or work in STEM fields, whether the girl has intersecting vulnerable characteristics, such as race, poverty, disability.

Through multiple levels of analysis, coupled with the process of comparison that makes the familiar become unfamiliar and the unfamiliar become familiar, you will have a deeper understanding of the problem.

Despite the significant recent efforts to focus research attention on the importance of taking context into consideration (Cowen, 2006; Crossley, 2009; Vavrus & Bartlett, 2009), the field of comparative education remains hobbled by unsophisticated and inadequately theorized notions of context. As the contextual characters of comparative policy, it's significant to take into account the policy context (Sobe & Kowalczyk, 2013).

This paper compares gender equality in STEM fields through three levels. Under these three levels, this study will also discuss the points of similarity or divergence that are worthy of attention in STEM fields. In terms of regional characteristics, since regional characteristics are related to historical and cultural background characteristics, the depth of comparative analysis under regional characteristics will be strengthened through social background, gender equality development background, higher education background, cultural background and other aspects of regional characteristics.

As for the population section, due to the differences in the gender gap between STEM subjects, the section focuses about female students in different disciplines and different geographical locations, as well as the actual factors related to poverty that hinder or affect women's pursuit of STEM. For the policy component, thematic analysis is used to examine the contrast between policy priorities and existing challenges. In the end, combined all the level of comparison together to discuss what can we learn from the similarities and difference between Policies of China and Italy.

2.2.4 Expert Interview

The expert interview is a qualitative empirical research (Monke,2021; Döringer,2021) in policy research, as a stand-alone method or part of a more comprehensive set of methods or as part of a triangulation (Van&Donders,2019; Monke,2021), to explore or collect data about a specific field of interest in a more efficiency way (Bogner et al., 2009). To conduct an expert interview,

firstly is important to identify what can we get from the expert, in other words, what is supposed to be the expert knowledge.

There are no definite requirements for the format of expert interviews. Koolwijk (1974) understood expert interviews as non-standard *investigative and informational interviews*, while Scheuch (1973) suggested using interview guide for this *special form of questioning* to deepen pre-scientific knowledge. In this study, interviews also do not follow a specific format, targeting the content of the information provided by the experts while ignoring its fixed form. In the interview invitation, the interviewee provides alternative interview methods to realize it. Invitees may participate via Zoom, providing audio or video responses, offering written materials, or simply answering the questions by email. But in the end, most of the experts chose to share their experiences and opinions online via zoom especially for problems of a long distance.

The expert interview, according to Meuser and Nagel (2009), is a guideline-based qualitative interview that emphasizes the expert's knowledge, which is generally classified as specific knowledge in a particular sphere of action · combining qualitative interviewing approaches for investigating implicit expert knowledge

To design an outline of expert questions, there are three steps that need to be followed. Firstly, to identify the topic of interview which is the specific research aim of doing expert interview. Secondly, to define the possibilities of the problems cause the research topic. Thirdly, to design questions under the problem to figure out. (Figure 1)

Figure 1. Research Question Design
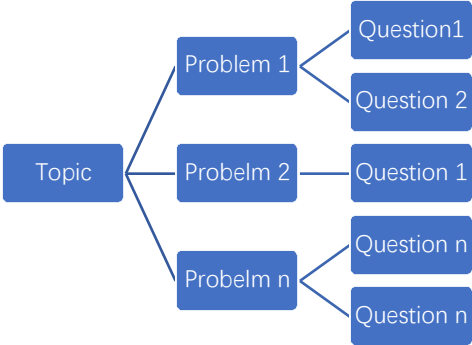
After that, to choose 5-6 key questions from the questions list based on the research design.

Table 3 attached shows all the crucial questions identified according to the problems of gender inequality in STEM in higher education (Table 3).

The expert interview is a kind of non-standard interview, and its question formula and questions order are not binding. However, it is usually guided by pre-determined guidelines on topics and issues (Glaser et al. 2004, p. 39). With the direct of research aims at seeking the knowledges on the challenges and directions for policies on promoting gender inclusive, equitable quality STEM higher education through different level (country level, institution level, individual level), six guild-line questions were chosen (Table 2).

Table 2. Main Expert Interview Questions Guideline

	QUESTIONS
1	How does the implicit gender bias in higher education manifest itself in student admission, teaching, evaluation, teacher training, student community communication, award selection, program application, research, and other aspects of university life?
2	What policies have you implemented in your career to promote gender equity in STEM in higher education? Can you describe the advantages and obstacles of the policy?
3	What measures has your university implemented to advance gender equality in STEM education, including curriculum design, faculty training, on-campus initiatives, and so on?
4	What measures should universities take to support female students in STEM fields?
5	Do you believe that women in STEM require additional mentorship in universities to address the issue of their under-representation? If so, can you explain how universities can provide effective mentorship to women in STEM?
6	Could you provide some policy recommendations aimed at building an inclusive environment to foster gender equality in STEM fields within higher education?

Table 3. Key Questions List to Prioritize

THEME	How to build gender inclusive environment to promote gender equity in STEM in HE through promotion of education policy?
PROBLEM 1	The core difficulty for female student in STEM in higher education.
QUESTIONS	1.1 What do you believe are the primary elements of STEM higher education at your university that could impede women from achieving success in the field? 1.2 Could you elaborate on any effective measures taken in your country to support women in STEM? 1.3 What measures do you think universities should take to support female students in STEM fields?
PROBLEM 2	Gender stereotype that link man to STEM not women，STEM temperament, STEM organization culture.
QUESTIONS	2.1 Could you share your experience regarding gender bias in STEM in higher education? 2.2 Have you ever attempted to alleviate the gender bias that typically associates men, but not women,

	with STEM professions in your teaching career? What motivated you to do so and how did you go about it?
	2.3 What policies do you think can be implemented to promote effective teaching strategies that reduce gender stereotypes linking males to STEM and create a gender inclusive environment in college?
	2.4 Did you observed that female student in STEM will reject traditional femininity for a "female masculinity" to be "one of the boys" to negotiate the limited possible identities for them as female students in the field? What are your thoughts on this?
	2.5 How does the implicit gender bias in higher education manifest itself in student admission, teaching, evaluation, teacher training, student community communication, award selection, program application, research and other aspects of university life?
PROBLEM 3	Lack of mentorship to women.
QUESTIONS	3.1 Do you believe that women in STEM require additional mentorship in universities to address the issue of their under-representation? If so, can you explain how universities can provide effective mentorship to women in STEM?
	3.2 Are there any policies in your country that advise providing mentorship to guide and encourage women in STEM in higher education?
Problem 4	Teacher 's influence in the higher education process is needed.
QUESTIONS	4.1 How did your country encourage teachers to promote gender equity in STEM in higher education?
	4.2 Have you ever been involved in creating a STEM curriculum that is inclusive of all genders? If so, can you explain the focus of the changes and share your thoughts on the matter?
	4.3 Have you ever taken any courses on Gender-inclusive pedagogy offered by universities for staff? If so, when, where, and what was the format of the course?
PROBLEM 5	The effectiveness of policies.
QUESTIONS	5.1 What policies have you implemented in your career to promote gender equity in STEM in higher education? Can you describe the advantages and obstacles of the policy?
	5.2 Could you elaborate on any effective strategies implemented in your country to promote female students in STEM fields in higher education?
	5.3 What measures can professors of STEM, feminist sociologists, researchers, and other stakeholders in universities take to advance gender equity in STEM?
	5.4 Does your nation or universities have any policies in place to foster a gender-inclusive atmosphere in STEM-related higher education? If so, what are the policies?
	5.5 Does your country or university have any policies in place to track the learning progress and graduation rate of women in STEM compared to that of men, and any initiatives to bridge the gender gap?
	5.6 What are some of the reasons why policies to foster gender equality in STEM fields in higher education in your country haven't been successful?
	5.7 Does your higher education institution possess a gender office that bears the responsibility of enforcing gender equality? Assuming it does, what is the composition of the office and what are its long-term aspirations?
	5.8 Has your higher education institution established a comprehensive set of values regarding gender equality? If so, how was this set of values developed and how has it been integrated into the institutional culture?
	5.9 What measures has your higher education institution implemented to advance gender equality in STEM

| | education, including curriculum design, faculty training, on-campus initiatives and so on? |
| | 5.10 What policies can be implemented to encourage universities to collaborate with society, NGOs, and other stakeholders in STEM-related education, research, and innovation to advance gender equality in STEM? |

2.3 Theoretical framework

In essence 'theory' is about the ability to get above your reading and your findings to see a shape in them, to devise, metaphorically, some sort of organizing template through which you can look at you're reading and findings. It's about seeing the interconnections and trying to understand how and why they exist. It's about going beyond mere description to explanation (Thomas, 2013, p155) Therefore, theory is a heuristic tool to inspire and help researchers to think about specific problems through the guidance of theory. With the help of theory, we can explore the connotation of the problem from a refined perspective, which help in deepening the knowledge. Choosing different theories means choosing different thinking directions and angles and drawing different thinking conclusions.

2.3.1 Education Right

Women's right to higher education is also usually limited by subject, for example, there are fewer females enrolled in STEM careers due to cultural norms and stereotypes (UNESCO IESALC, 2021; UNESCO, 2022; Sabzalieva et al.,2022). The emphasis on the right to education is based on the obligation of the State to protect, respect, and fulfil the right to education of all citizens, and on the role that education itself plays in promoting the process of gender equality and achieving sustainable development. As the vision of the 2015 Incheon declaration stated: Inclusion and equity in and through education is the cornerstone of a transformative education agenda (UNESCO,2015).

Education was recognized as a human right in 1948. Universal Declaration of Human Rights Article 26 states that (i) everyone has the right to education; (ii) education is aimed at the full development of the human personality and at strengthening respect for human rights and fundamental freedoms.

In 1960, the UNESCO Convention against Discrimination in Education specified what governments must do to prevent 'nullifying or impairing equality of treatment in education' present as 'distinction, exclusion, limitation or preference' based on 'race, colour, sex, and language' (Article 1). It focused on ensuring that all learners enjoyed equal access to, and quality of, education with respect to human dignity.

Limitation of All Forms of Discrimination Against Women (CEDAW) in 1979, recognizing that to achieve full equality between men and women, the traditional roles of men and the roles of women in society and the family needed to be changed (table 4). Eliminating the gender stereotype in education is also highlighted.

Table 4. Articles of Elimination of All Forms of Discrimination Against Women Addressing Traditional Gender Role Transformation

ARTICLE 5 *States Parties shall take all appropriate measures:*   *(a) To modify the social and cultural patterns of conduct of men and women, with a view to achieving the elimination of prejudices and customary and all other practices which are based on the idea of the inferiority or the superiority of either of the sexes or on stereotyped roles for men and women…*
ARTICLE 10 *States Parties shall take all appropriate measures to eliminate discrimination against women in order to ensure to them equal rights with men in the field of education and in particular to ensure, on a basis of equality of men and women:*   *…(c) The elimination of any stereotyped concept of the roles of men and women at all levels and in all forms of education by encouraging coeducation and other types of education which will help to achieve this aim and, in particular, by the revision of textbooks and school programmes and the adaptation of teaching methods... (UN Women,1979)*

The Beijing Declaration and Platform for Action, adopted in 2005 by 189 Member States meeting in Beijing, China, continue to play an important role in the road map for achieving gender equality. This key document continues to guide the global fight against restrictions and obstacles to women's empowerment around the world. In that framework, it was emphasized that measures should be taken to refine gender stereotypes in education, in particular gender bias in science curricula. (Table 5) The outline, which suggested creating an educational and social environment in which women and men are treated equally and encouraged to reach their full potential, was the initial narrative of a gender-inclusive environment. It recognized that

stereotyped images of women and men were one of the causes of gender inequality and that the promotion of non-gender stereotyped images would effectively eliminate inequality for women and men. The direction of changing gender stereotypes is directed towards curricula, teaching materials and educators. Gender bias in curricula and teaching materials and the omission of images of girls and women, often reinforcing gender stereotypes in the work of educators at all levels, are major problems. Finally, the focus is on the science curriculum, and the outline points out that there is a gender bias in science curriculum. There is a lack of representation of women and recognition of women scientists in science textbooks (Article 75). Girls are often removed from basic education in mathematics, science and technical training at the basic level, leading to a distance from scientific careers. Article 76 of the outline also points out that girls' learning in higher education is still concentrated in some areas of the problem. The Beijing Platform for Action on gender inequality in education is still an important guide for promoting gender equality. The social model is linked to the rights-based approach to inclusion and the idea that education needs to be available, accessible, acceptable and adaptable (Tomaševski, 2001). To sum up, the State should fully fulfill its obligations, promote the realization of women's right to education in accordance with the framework that the right to education should be available, accessible, acceptable and adaptable, and focus on reducing gender stereotypes and gender bias in education policies. And focus on promoting gender inequality in scientific disciplines.

Table 5. Articles on Gender Stereotype in Education in The Beijing Platform for Action in 1995

ARTICLE 72. Creation of an educational and social environment, in which women and men, girls and boys, are treated equally and encouraged to achieve their full potential, respecting their freedom of thought, conscience, religion and belief, and where educational resources promote non-stereotyped images of women and men, would be effective in the elimination of the causes of discrimination against women and inequalities between women and men.
ARTICLE 74. Curricula and teaching materials remain gender-biased to a large degree and are rarely sensitive to the specific needs of girls and women. This reinforces traditional female and male roles that deny women opportunities for full and equal partnership in society. Lack of gender awareness by educators at all levels strengthens existing inequities between males and females by reinforcing discriminatory tendencies and undermining girls' self-esteem. The lack of sexual and reproductive health education has a profound impact on women and men.
ARTICLE 75. Science curricula in particular are gender biased. Science textbooks do not relate to

women's and girls' daily experience and fail to give recognition to women scientists. Girls are often deprived of basic education in mathematics and science and technical training, which provide knowledge they could apply to improve their daily lives and enhance their employment opportunities. Advanced study in science and technology prepares women to take an active role in the technological and industrial development of their countries, thus necessitating a diverse approach to vocational and technical training. Technology is rapidly changing the world and has also affected the developing countries. It is essential that women not only benefit from technology, but also participate in the process from the design to the application, monitoring and evaluation stages.

ARTICLE 76.   Access for and retention of girls and women at all levels of education, including the higher level, and all academic areas is one of the factors of their continued progress in professional activities.   Nevertheless, it can be noted that girls are still concentrated in a limited number of fields of study.

2.3.2 Gender Inclusive and Equitable Quality Education

Gender equality and equity in education have been key aspects of the international initiative 'World Conference on Education for All' (Jomtien, Thailand, 1990). The concept of education for all put forward higher requirements for the quality of education and the protection of human rights in education. However, since the World Conference on Higher Education in 1998, it has been proposed to promote sustainable human development through the construction of a gender-inclusive education environment. At the 48th International Conference on Education (ICE, November 2008), Ministers of Education and heads of delegation from 153 UNESCO Member States affirmed that inclusive quality education that meets the diverse needs of all learners is relevant, equitable, effective, and essential for achieving human, social and economic development. Gender equality in STEM higher education is related to the realization of women's right to quality education in higher education and the fulfilling of women's potential, which has positive significance for the sustainable development of society and developed from the Sustainable Development Goals of the United Nations. As is mentioned in "Transforming our World: The 2030 Agenda for Sustainable Development" (Table 6), in the preamble of the agenda, the aims for sustainable development including "seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls", "ensure that all human beings can fulfil their potential in dignity and equality and in a healthy environment" (UN, 2015, p1-2). In addition to the preamble, in point 20 of the main text, the promotion of

equality between women and men and the full potential of women are again emphasized as central to achieving sustainable development. Gender discrimination, social stereotypes, and the suppression of the potential of half the population not only affect the realization of women's human rights, but also hinder the development of society. This is specified in article 25 of the main text, "We commit to providing inclusive and equitable quality education at all levels — early childhood, primary, secondary, tertiary, technical and vocational training. All people, irrespective of sex, age, race or ethnicity, and persons with disabilities, migrants, indigenous peoples, children and youth, especially those in vulnerable situations". This article highlights the idea of "education for all" and "No one must be left behind". The word inclusive and equitable should include all kind of people in adverse especially vulnerable situation. All people in all levels of the education should be inclusive in the education system to achieve its full potential. This research will highlight the gender perspective and focus on the women in the vulnerable background to enjoy a full accessibility to STEM HE. What's more, the sustainable development goal 4 (SDG 4) ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all, and the SDG 5 commits to achieving gender equality and empower all women and girls (UN, 2015, p14). In the targets of SDG4, 4.3 ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, 4.5 eliminate gender disparities in education, 4.a indicates that build and upgrade education facilities that are child, disability and gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all. Therefore, SDG4 is targeting in promoting gender quality education from the aspects of equal opportunities, affordable and quality, reducing gender differences, and building gender-sensitive education facilities.

But for what is gender inclusive and equitable quality education in the whole agenda, "equal access", "end all forms of discrimination", "eliminate gender disparities in education", "affordable", "human rights", "facilities that are gender sensitive" and "no one must be left behind" are the phrases that are related, but thesis definition is still vague and sketchy which approve many operational possibilities. In the book *Guidelines for Inclusion: Ensuring Access to Education for All*, inclusion is seen as a process of addressing and responding to the diversity

of needs of all children, youth, and adults through increasing participation in learning, cultures and communities, and reducing and eliminating exclusion within and from education. It involves changes and modifications in content, approaches, structures, and strategies, with a common vision that covers all children of the appropriate age range and a conviction: it is the responsibility of the system to educate all children (UNESCO, 2005). *The 2020 Global Education Monitoring Report* gives a richer definition of inclusive and equitable quality education. In the report is stated that, firstly, education for all is the foundation of inclusion in education. Inclusion cannot be achieved if it is seen as an inconvenience or if people harbor the belief that learners' levels of ability are fixed which means education systems need to be responsive to all learners' needs. Equity and inclusion have become the heart of *the 2030 Agenda* because inequalities persist in world in the distribution of resources and opportunities related to characteristics such as gender, remoteness, wealth, disability, race, language, migration, displacement, incarceration, sexual orientation, gender identity and expression, religion, and other beliefs and attitudes (UNESCO,2020). The difficulty located at the fact that structural barriers always exist, advantages and disadvantages are passed from generation to generation. Organizations and institutions may favor some groups over others and spread social norms and stereotypes that deny opportunities to more vulnerable groups (UNESCO,2020). Secondly, inclusion in education is not just result, it's a process. When equality is a state of affairs (what): a result that can be observed in inputs, outputs or outcomes, Equity is a process (how): actions aimed at ensuring equality. Inclusion is more difficult to define, as it's used in *2020 Global Education Monitoring Report*. It's a state of affairs, a result, a process that actions and practices that embrace diversity and build a sense of belonging, rooted in the belief that every person has value and potential and should be respected. As its stated in the article 7 of the 2015 Incheon Declaration: Inclusion and equity in and through education is the cornerstone of a transformative education agenda, and we therefore commit to addressing all forms of exclusion and marginalization, disparities and inequalities in access, participation and learning outcomes (UNESCO, 2015, p 3).

From all these UNESCO 's articles, gender inclusive and equitable education means the

education systems have to focus on the need of all gender and eliminate the barrier for all gender to achieve their potential. Inclusion in education can advance gender equality in and through education (Table 6).

Table 6. Equity, Inclusion and Quality Education in Transforming Our World: The 2030 Agenda for Sustainable Development

SUSTAINABLE DEVELOPMENT GOALS	SDG 4 TARGETS
Ensure inclusive and equitable quality education *and promote lifelong learning opportunities for all (SDG 4)*	*... ensure that all girls and boys complete free, equitable and quality primary and secondary education ... (4.1)*
Achieve gender equality and empower all women and girls (SDG 5)	*... ensure **equal access** for all women and men to **affordable and quality** technical, vocational and tertiary education ... (4.3)*
*Promote sustained, **inclusive** and sustainable economic growth, full and productive employment and decent work for all (SDG 8)*	*... **eliminate gender disparities in education** and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations (4.5)*
*Build resilient infrastructure, promote **inclusive** and sustainable industrialization and foster innovation (SDG 9)*	*Ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, **human rights**, **gender equality**, promotion of a culture of peace and non-violence, global citizenship and **appreciation of cultural diversity** and of culture's contribution to sustainable development. (4.7)*
Reduce inequality within and among countries (SDG 10)	
*Make cities and human settlements **inclusive**, safe, resilient and sustainable (SDG 11)*	*Build and upgrade education facilities that are child, disability and **gender sensitive** and provide safe, non-violent, **inclusive and effective learning environments for all**. (4.a)*
*Promote peaceful and **inclusive societies** for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels (SDG 16)*	
SDG 5 TARGETS	MAIN TEXT:QUALITY EDUCATION
*End all forms of **discrimination** against all women and girls everywhere. (5.1)*	***Women and girls must enjoy equal access to quality education**, economic resources and political participation as well as equal opportunities with men and boys for employment, leadership and decision-making at all levels. (§20; The new Agenda)*
*Enhance the use of enabling **technology**, in particular information and communications technology, to promote the empowerment of women. (5.b)*	*We commit to providing **inclusive and equitable quality education** at all levels — early childhood, primary, secondary,*

Adopt and strengthen sound policies *and enforceable legislation for the promotion of gender equality and the empowerment of all women and girls at all levels. (5.c)*	*tertiary, technical and vocational training. All people,* ***irrespective of sex****, age, race or ethnicity, and persons with disabilities, migrants, indigenous peoples, children and youth, especially those in vulnerable situations, should have access to life-long learning opportunities that help them to acquire the knowledge and skills needed to exploit opportunities and to participate fully in society. We will strive to provide children and youth with a nurturing environment for the full realization of their rights and capabilities, helping our countries to reap the demographic dividend, including through safe schools and cohesive communities and families. (§25)*
MAIN TEXT: EQUITY, INCLUSION	**MAIN TEXT: LEAVING NO ONE BEHIND**
...to protect human rights and promote ***gender equality*** *and the empowerment of women and girls ... (§3; Introduction)*	*...to ensure that all human beings can* ***fulfill their potential*** *in dignity and equality and in a healthy environment. (people)*
A world with equitable and universal access to ***quality education*** *at all levels, to health care and social protection ... (§7; Our vision)*	*... we pledge that no one will be left behind (Preamble)*
... a world of universal respect for human rights and human dignity, the rule of law, justice, ***equality*** *and* ***non-discrimination****; of respect for race, ethnicity and cultural diversity; and of* ***equal opportunity*** *permitting the full realization of human potential ... (§8; Our vision)*	*... we will endeavour to reach the furthest behind first (§4)* *No one must be left behind (§24; health)* *Quality, accessible, timely and reliable disaggregated* ***data*** *will be needed to help with the measurement of progress and to ensure that no one is left behind (§48; data)*
A world in which every woman and girl enjoys full gender equality and all legal, social and economic barriers to their empowerment have been removed. A just, equitable, tolerant, open and socially inclusive world in which the needs of the most vulnerable are met. (§8;Our vision)	*A robust, voluntary, effective, participatory, transparent and integrated follow-up and review framework to ensure that no one is left behind (§72; follow-up and review framework)*
There are rising inequalities within and among countries. There are enormous disparities of opportunity, wealth and power. Gender inequality remains a key challenge. (§14)	*...* ***people-centred****,* ***gender-sensitive****, respect human rights and* ***have a particular focus on the poorest, most vulnerable*** *and those furthest behind (§72; follow-up and review processes)*
Realizing gender equality *and the empowerment of women and girls will make a crucial contribution to progress across all the Goals and targets. The achievement of* ***full human potential*** *and of sustainable development is not possible if one half of humanity continues to be denied its full human rights and opportunities. Women and girls must enjoy equal access to quality education, economic resources and*	

*political participation as well as equal opportunities with men and boys for employment, leadership and decision-making at all levels. We will work for a significant increase in investments to **close the gender gap** and **strengthen support for institutions in relation to gender equality** and the empowerment of women at the global, regional and national levels. All forms of discrimination and violence against women and girls will be eliminated, including through the engagement of men and boys. The **systematic mainstreaming of a gender perspective** in the implementation of the Agenda is crucial. (§20; The new Agenda)*	

Source: United Nations (2015).

2.3.3 Analysis Framework for Gender Inclusive and Equitable Quality Education Policy in STEM HE

According to the United Nations Sustainable Development Goals, gender equality is one of the core values of education, used to guide policy development and to provide quality educational opportunities for students. Although the national policy contains provisions and requirements to promote gender equity, gender inequality still exists in higher education especially gender segregation still exist in STEM. The aim of this study is to critically analyze gender equity policies in STEM higher education in Italy, Europe, and China to determine whether and how the policies are aimed at achieving inclusive, equitable and high-quality education in STEM HE.

The framework used in this study for comparative analysis of policies on improving gender inclusive and equitable quality STEM higher education is drawn from the European Agency for Education, The Policy Analysis issues raised in the Country Policy Review and Analysis (CPRA) published by Special Needs and Inclusive Education (EASNIED, 2018). The framework it's constructed based on the guidance document Analysis Framework for Mapping Inclusive Education Policies developed based on CPRA.

As it was mentioned in part II Women and Development: Guiding Principles of the UNESCO paper prepared for the World Conference on Higher Education in 1998 that "Firstly, UNESCO

aims to foster a gender-inclusive culture through education, including higher education, in order to promote sustainable human development and peace" (UNESCO,1998).

While SDG 4 envisions inclusive education as encompassing all children, youth and adults in different kind of unfavorable situation including gender, inclusive education has historically been associated more with or conceptualized as education for children with disabilities. The endeavor and struggle to support people with disabilities has therefore bring rich knowledge on the core to promote inclusion.   The following is a brief introduction to the CPRA and *Analysis Framework for Mapping Inclusive Education Policies* and explains how to use its contents for comparative analysis of policy documents (EASNIED, 2018).

The CPRA work's overall purpose is to aid country reflection regarding the development of policy for inclusive education (EASNIED,2018). Analysis Framework for Mapping Inclusive Education Policies (AFMIEP) is built on the basis of CPRA including two sections: Legislation and policy for inclusive education system and operational structures and process. As the research focus of the third part of study is policy, this study will refer to the policy section of the AFMIEP framework. In the policy analysis section, the CPRA and AFMIEP include 19 questions (Table 7).

Table 7. Mapping Questions for Policy to Improve Inclusive Education and to Ensure that Good Quality Education is Accessible for All

1.	Is policy guided by a clear vision that inclusive education increases quality and equity for all learners?
2.	Does policy support the implementation of every learner's right to inclusive and equitable educational opportunities and is it consistent with the principles of the UNCRC and the UNCRPD?
3.	Does policy support the implementation of every learner's right to inclusive and equitable educational opportunities and is it consistent with all relevant European equality, anti-discrimination, and disability rights directives?
4.	Does policy aim to **widen access to education and promote full participation** and opportunities for all learners vulnerable to exclusion to realize their potential?
5.	Is there a **long-term, multi-level policy framework** for implementing quality inclusive education at national, regional and/or organizational levels?
6.	Does policy have the **goal of increasing enrolment rates and participation** in high- quality inclusive early childhood education and care?
7.	Does policy ensure that pre-school places are offered to children coming from early childhood education services/provision?
8.	Does policy outline **how cost-free services/provision** across all system levels are provided for learners and their

	families **as early as possible and as quickly as possible**, following identification of need?
9.	Does policy outline the support available for families to enable them to recognise and understand their child's needs?
10.	Does policy state that, **in risk situations**, the child's rights should come first?
11.	Does policy have the goal of ensuring the full involvement of families in all educational processes?
12.	Does policy **clearly respect the rights and the needs of children and their families**, taking their views and opinions into account in all educational processes?
13.	Are policy goals and objectives for inclusive education clearly integrated in all areas of general education policy?
14.	Is policy for inclusive education **cross-sectoral**?
15.	Are policies based upon universal design and all-inclusive principles?
16.	Do policy outline procedures to ensure the **efficient co-ordination** of services with clearly defined roles and responsibilities?
17.	Does policy describe an **effective framework of support for schools** to implement inclusive education across all system levels?
18.	Do **local** (regional/municipality) level policies aim to **reduce system inequities** and fragmentation across regions?
19.	Do **local** (regional/municipality) level policies aim to **promote more equitable and effective provision** for all learners?

Since this paper studies policies to promote STEM gender inclusion and equality in high quality education in higher education, it removes issues that include other education stages and focuses on gender inclusion and equality in higher education policies. Thus, the analysis of policy on gender inclusive and equitable quality STEM HE in Italy, Europe and China will be guided by these 5 questions as:

a) Vision: Is policy guided by a clear vision that increases quality and equity for all learners through inclusive education?

b) Implementation: Does Policy Support the Implementation of Female Learner's Right to Gender Inclusive and Equitable Educational Opportunities?

c) Vulnerability: Does policy aim to widen access to education and promote full participation and opportunities for all learners vulnerable to exclusion to realize their potential?

d) Framework: Is there a long-term, multi-level policy framework for implementing quality gender inclusive education at national, regional and/or organisational levels?

e) Needs: Does policy outline how provisions are provided for learners following identification of need?

In this thesis, the policies will be analysis through the framework of 5 questions, through the

framework from vision, implementation, vulnerability, framework, and needs. Table 8 shows some descriptions for the 5 questions.

Table 8. Description of the 5 Aspect of the Gender-inclusive Education Policy Framework

QUESTION	DESCRIPTION
Vision: Is policy guided by a clear vision that increases quality and equity for all learners through inclusive education?	As the European Agency's position paper states: 'The ultimate vision for inclusive education systems is to ensure that all learners of any age are provided with meaningful, high-quality educational opportunities in their local community, alongside their friends and peers' (European Agency, 2015, p. 1). Such a goal requires changing the educational culture in teaching and support practices. It requires moving away from a 'one-size-fits-all' education model, towards a tailored approach to education that aims to increase the system's ability to respond to learners' diverse needs without the need to categorise and label them (EASNIED,2017, P 7). Inclusive education therefore means attributing learners' difficulties to schools' inabilities to compensate for different starting positions, rather than to individual weaknesses (UNESCO, 1994). It builds on schools developing a learner-centred approach (Rouse and Florian, 1996; OECD, 1999; Booth and Ainscow, 2002), engaging the whole school community to act as a supportive learning community. This community aims to support the weakest, while encouraging the strongest to achieve their best, and ensures all members feel respected, valued and are enabled to fully participate in the school community. Instead of seeking to fix learners or provide 'compensatory' support to learners who are different to fit them into existing arrangements, schools are invited to develop inclusive learning environments that are both universally accessible and adapted to each learner's needs (EASNIED,2017, P 7).
Implementation: Does Policy Support the Implementation of Female Learner's Right to Gender Inclusive and Equitable Educational Opportunities?	Inclusive education as a way for addressing and responding to the needs of all learners (Geneva, 2008). UNESCO has also defined inclusive education as "a process of addressing and responding to the diversity of needs of all learners through increasing participation in learning, cultures and communities, and reducing exclusion within and from education [...]" (Acedo et al., 2011, p).
Vulnerability: Does policy aim to widen access to education and promote full participation and opportunities for all learners vulnerable to exclusion to realize their potential?	As Council of Europe plan to Contribution to the UN Sustainable Development Goals 4.5 Gender equality and inclusion presented: by 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations.
Framework: Is there a long-term, multi-level policy framework for implementing	Inclusive education guides all educational policies and practices, intertwining different dimensions (access, processes, participation and learning outcomes), levels (formal, non-formal, adult education) and units (national frameworks, curricula, schools, classrooms,

quality gender inclusive education at national, regional and/or organizational levels?	teachers and learners). Inclusive curricula can only be efficiently developed and implemented within systemic approaches that provide schools, teachers and other staff, with the orientation and necessary supporting conditions to progress from vision to practice (Acedo et al., 2011, p 14).
Needs: Does policy outline how provisions are provided for learners following identification of need?	For most countries, policies have a clear focus on what special needs provision a learner may require rather than solely in learner factors, such as a type of disability or impairment (Acedo et al., 2011, p 104). It is for this reason that the member countries of the European Agency for Development in Special Needs Education (the Agency) have agreed that the most useful approach to collecting any form of data on special needs education is to take a "bottom-up" approach that uses the country's own legal definition of SEN as the basis for data collection (Acedo et al., 2011, p 105).

2.4 Research Sampling

2.4.1 Standard of Choosing Policies

Get to the part of collecting data, the validity and reliability of collecting samples should pay attention to. As the key point of validity is appropriate and accurately to answer the research questions. The research question in my study is, facing the issue of the gender gap in STEM higher education, how did Policies in Italy and China try to deal with gender stereotypes and norms that excluded or discouraged women's possibilities in STEM fields in higher education to achieve gender equality and inclusion in STEM fields. To answer this question, the purposive sampling is being used. The content of the policies is supposed to be about gender equality in education, STEM, female and academic, female and technology should be focusing on. The types of policies included laws, administrative regulations, programs and other public political instruments and tools. The way of gathering policies is through the official websites. As the purposive sampling should be used to choose policies, the official website in charge of gender equality, higher education should turn to. After searching the policies, the content of the policies is also important, it should be checked about if the content is closely relavant. Through the process of searching and initially reading, there are 13 policies being selected. (Table 9; Table 10)

Table 9. List of Policies in China on Promoting Gender Equality in STEM in HE

POLICY 1	National Human Rights Action Plan (2021-2025)
POLICY 2	Outline for the Development of Chinese Women (2021-2030)
POLICY 3	Seven departments jointly issued the Opinions on Implementing the Action of Women in Scientific and Technological Innovation (2021)
POLICY 4	The Ministry of Science and Technology and 13 other departments issued a circular on Measures to support female scientific and technological talents to play a greater role in scientific and technological innovation (2021)
POLICY 5	*China's Education Modernization 2035*

Table 10. List of Policies in Italy on Promoting Gender Equality in STEM in HE

POLICY 6	National strategy for gender equality 2021-2026
POLICY 7	National recovery and resilience plan in Italy (PNRR)
POLICY 8	Woman for a new one renaissance (2020)
POLICY 9	Guidelines for guidance 2022
POLICY 10	Guidelines for the gender budget in Italian universities
POLICY 11	National guidelines (art. 1 paragraph 16 l. 107/2015) Education to respect: for gender equality, the prevention of gender violence and all forms of discrimination
POLICY PROPOSAL 12	Affirmative action directions for gender issues in universities and research
POLICY PROPOSAL 13	Analysis and proposals on the issue of gender in the Italian university world

2.4.2 Standard of Constructing Expert Panel

Dexter's (2006) hold a classic understanding that, an expert is any person who has specialized information on or who has been involved in the political or social process of interest. The expert can be different type of people, they can be "Academics, practitioners, political elites, administrators or any other individuals with professional experience or knowledge" (Maestas, 2015). Their insights respond to a fundamental challenge that many of the issues of interest in the political and social sciences cannot be directly observed, documented, or transparent (Von, 2023).

The debate about expert knowledge centers on what kind of knowledge is an expert. Schütz (1964, p123): the "expert," the "man on the street," and the "well-informed citizen" should be distinguished. The concept of developing experts by associating expert knowledge with

professional roles has been supported by more scholars (Meuser & Nagel,2005; Hitzler, 1991). Experts can be divided into different types based on the different types of expert knowledge they have. Based on the expertise role, the experts can be divided into with operational knowledge or contextual knowledge. According to Gläser&Laudel(2009), experts are either privileged individuals in a functional context or those with specialized understanding of social concerns.

The "quality" of the interviewee, or how well they live up to our expectations in an interview setting, is a key factor in the success of interview-based surveys. Based on understanding the types of experts, the selection of experts still needs to be based on the research problem. The research questions designed in this paper are concerned with the formulation of policies to promote gender inclusion and equality in quality education, and the barriers to promoting gender equality and inclusion in higher education environments. So first of all, there can be little doubt that researchers are "experts in the field." But as the academic abilities differ, the standard to select can be the price won on published, the title, the project value, the expertise interest. And as academic in the university, in the process of working in universities, she must experience the implementation of relevant policies and have a more in-depth view based on her background. Therefore, the scholar in universities who takes gender equality in STEM as one of his main research interests or enven famous for his study on this field is one of the experts I choose. Secondly, professors who teach in STEM fields should have their own ideas about the gaps and core points in the construction of gender equality and inclusive environment in STEM fields, and if they are advocates of gender equality in STEM fields or members of gender equality organizations in STEM fields, Therefore, there should be more in-depth knowledge of gender equality in STEM fields, which is also the object of this study. In addition, people who oversee STEM gender equality programs in higher education institutions, because they are executors of gender equality programs and gender equality programs, have many practical perspectives on promoting gender equality and inclusion in STEM fields, and are also experts selected for this article.

On this basis, this study invited five experts to form an expert panel. (Table 11) It can be

mentioned that the first and third types of experts invited in the research process have relatively rich responses to the questions. However, in the case of several professors who were invited to belong to the second group of experts, they all agreed to participate in the investigation and research, and then declined to answer further questions in a silent manner. Such a phenomenon also has certain enlightening significance for this study. Experts often cite lack of time, doubts about their own relevance to the research topic, or their own expertise and competence on the reseach questions guide' as reasons for refusing to be interviewed by experts (Gläser et al. 2004, p. 158). The interviewer has the following assumptions: due to the specific and in-depth questions selected in this study, professors who are not engaged in academic research on this issue may not be sure of their answers to this question, and the practical questions may also reflect the formulation of some policies to promote gender equality in STEM fields. There is a certain gap between implementation and practice, which makes it difficult for experts to find examples when answering questions. These assumptions can be further tested by other studies. In addition, a professor from Stanford University also accepted the interview, during which he answered the focus and direction of the topic, which played a role in promoting the study. However, for some reasons, he did not reply to the specific questions of the study.

Table 11. Expert Panel Information

	EXPERT	COUNTRY OF RESIDENCE	EXPERT BACKGROUND	KNOWLEDGE AND INTEREST
1	Yinghui Cai	China	Coordinator Of STEAM Project. Director of Personnel Department	Manager and coordinator of STEAM project of Shude Girls'college. As dean of Shude Girls' College, she believed that Respecting women's right to education, improving women's education environment, and optimizing all kinds of education policies and operating mechanisms at all levels are the due meaning of Chinese-style modernization and high-quality development.
2	Hyun Kyoung Ro	USA	Researcher in Education department	Her research expertise includes Gender and Racial Equity in Science, Technology, Engineering, and Mathematics (STEM) Education. For example, she co-edited books Gender Equity in

				STEM in Higher Education, International Perspectives on Policy, Institutional Culture, and Individual Choice, and she study effect of gender and race Intersectionality on students learning outcome in Engineering.
3	Henriette Tolstrup Holmegaard	Denmark	Researcher in science education department. Conductor of STEM gender equality project (GATE)	Research interest on university pedagogy in general and in particular science and engineering higher education programmes. Research interested in how student navigate when meeting content, lectures, teaching and learning cultures and routines - in relation to the mechanisms of gender inclusion and exclusion embedded in the study programme. Conducting GATE project investigates why a large proportion of the young women refrain from continuing from high school into higher education science and engineering.
4	Expert who works in STEM university in Slovakia	Czech Republic	Gender quality project manager	Coordinated CHANGE (to support research performing organizations (RPOs) to design and implement gender equality plans). Responsible on drafting the university gender quality plan.
5	Expert who works in education department in Italy	Italy	Researcher In Education department	She is an expert in gender pedagogy and equal opportunities. Her studies and researches are focused on exploring sexist stereotypes and educational choices, gender mainstreaming in teaching, Female students in the STEM disciplines and so on.

2.5 Ethical Consideration

The principle of informed consent guarantees the expert the right to freely decide whether to participate in the research process and to provide information about the purpose and procedure of the investigation, as well as to retain its anonymity (Gläser et al., 2004, pp. 51-53 and 140). For the expert interview, it's needed to make sure that the coconscious is made between the problems concern issues of confidentiality, privacy, and copyright. So, the participating expert need to sign and confirm her/his rights through ethical concerned form. The content of ethical concerned form contains the content about the participant had right to read the content of the research and have the opportunities to consider the information, ask questions and have had

these answered satisfactorily. Secondly, concerned the right to withdraw the point before 30/08/2023 without giving any reason. Thirdly, concerned the confidentiality. The expert need to confirm if she would like to be audio/video recorded. The participator needs to confirm that she understands how audio recordings/ videos/ photos will be used in research outputs. The expert must have knowledge about who will have access to personal data provided and how the data will be stored and what will happen to the data at the end of the project. Fourthly, about the copyright. The participator needs to confirm if she would like to be quoted with or without her name. Fifthly, about the right to check the transcript before using and the right to make a complaint. Sixthly, the copyright and confidence after the research if the participator would like the contribution to be used in other projects and future use.

2.6 Thematic Analysis of Policy Document and Expert Interview

Thematic analysis is a method for identifying, analyzing, and reporting patterns (themes) within data, which intends to construct and deconstruct research data set in detail (Braun, Clarke, 2006). Thematic analysis is suggested for identify important themes from the data, to understand how themes relate to one another and how they are manifested in the data, to use themes to generate new insights about a particular phenomenon. Additionally, due to the clear, easy-to-follow processes outlined by Braun and Clarke (2006, 2012, 2017), researchers suggested that thematic analysis is an ideal analytic method for novice qualitative researchers (Nowell et al. 2017). With the purpose of the research on policy document and expert interview transcript, thematic analysis methods are helpful to help construct the theme of the priority of policy and the logic and view of the expert panels. (Table 12)

As the research aims of this study is about recognized the policies directions and gaps through the policy analysis and explored the challenges within the implementation of policies and the possible direction in the future. The main idea is to find the patterns through analysis. So thematic analysis is used both for policy analysis and the expert interview analysis.

As the research framework for policy analysis and expert interview is a little bit different, so the detail of process of recognizing themes are a little bit different.

Firstly, familiar with the data. In the process of familiar with the document, write down some themes and codes. In the process in familiar with the policy document, it's useful to recognize the structure of the policies. As policies are very big amount of material, without knowledge in mind about how these policies are structural can be difficulty to seize the theme and miss inside. So it can be helpful to pay attention to catalogue of policies. And through the structure of policy in Italy and China, it can be recognized that, in Italian policies, there are always a big amount of content concentrate on the data concerned the policy topic when in Chinese policies, there will be a big part about the vision. As in the expert interview, some video recordings need to be transcript, the process of transcript is also the process of familiar with the data. In the process of listening to the recording many times to determine the transcribed content, it is also the process of becoming familiar with the text, writing down some of the original code and possible themes.

Secondly, create the initial code. Clarke & Braun (2013) argued that a common pitfall is to view the primary interview questions as equivalent as the themes. Usually, this way indicates that the data have been summarized and organized, rather than thoroughly analyzed. In the process of creating initial code, the author also tries to prevent the influence from the policy topic and also the interview questions. In the process of initial coding, it's crucial to pay attention to the respect the original words (Alhojailan, 2012). In the policy analysis, as different words used in the policies always show different point of political view, the selection of words are serious, it's more important to pay attention to the original word and witness the little difference. And in the expert interview, as expert are all expertise in this field, it's important to pay attention to the word they select. Moreover, as gender equality has a complicated view in the society, all though in this thesis, all the words concerned gender gap, gender bias, gender parity, gender equity are all view as in the same basket， it's still important to pay attention to the word used by expert and respect the original word.

The third phase involves recognizing themes. This entails grouping codes and recognizing the overarching theme for each group, thereby organizing codes into potential themes (Cruzes, & Dyba, 2011, September). Additionally, it involves collecting all pertinent data related to each

potential theme, while maintaining comprehensive records regarding the evolution and hierarchies of concepts and themes (Castleberr & Nolen, 2018).

The fourth step is defining and naming themes. Refine the specifics of each theme, creating precise definitions and titles for each one (Vaismoradi, Turunen& Bondas, 2013). Engage in peer debriefing for validation. Using the main theoretical framework concerned building a gender inclusive and equitable educational STEM higher education environment to analysis the themes and construct it to be a theme that more relevant to the research aims.

The fifth step is producing the report. Selecting important policy examples and expert viewpoint. Analysis of policy Relating back of the analysis to the research question and literature Describing process of coding and analysis in sufficient details Producing a scholarly report of the analysis Peer debriefing.

Table 12. Step-by Step Policies Analysis

STEP	DESCRIPTION OF THE STEP
1. Familiarizing with the interview data	Storing the policies data and the transcripts of expert interviews in well-organized files Using ATLAS.ti software to organize the data Reading and re-reading the data. Writing initial ideas of codes and themes
2. Generating initial codes	Across the entire data set, coding as detailed as possible and try to respect the original words
3. Identifying themes	Putting the code into groups, and recognized the theme of the group, putting the code into potential themes. Gathering all data relevant to each potential theme Keeping detailed notes about development and hierarchies of concepts and themes Peer debriefing
4. Defining themes	Refine the specifics of each theme, Generate clear definitions and names for each topic
5. Producing the report	Selecting important policy examples and expert viewpoint Linking the analysis back to the research question and existing literature Providing an in-depth account of the coding and analysis procedures Creating an academic report of the analysis Engaging in peer debriefing

Source:This table is built based on the work of Braun and Clarke (2006)

III. COMPARATIVE ANALYSIS OF THE POLICY ON ACHIEVING GENDER EQUALITY IN STEM HE IN ITALY AND CHINA

3.1 STEM Gender Gap in Higher Education in Italy and China: Segregation Trend, Atmosphere and Influence

3.1.1 Female STEM Students in Italy: Gender Segregation and Reverse Leaky Pipeline

According to the World Economic Forum's (WEF) Global Gender Gap Report 2022, Italy ranks 63rd out of 146 countries for which information is available (WEF, 2022). The 2022 European Gender Equality Index ranks Italy as one of the least gender-equal nations in the EU, with a score of 65 out of 100, putting it in 14th place. Italy's score falls below the EU28 average (68.6). Italy scored below the EU average in all aspects aside from "health". Italy's work domain score of 63.2 points has dropped by 0.5 points since 2019, meaning the country ranks bottom among all EU Member States. In the subarea of "work" and "segregation and quality of work", Italy scored 58.7 in 2020, a slight rise of 0.2 from 58.5 in 2012. In the area of "knowledge segregation", Italy scored 61.4, but in 2018, the figure totaled 66. The country's score has changed little since 2005 due to persistent gender inequality in the family sphere and social divisions at work. The distribution of women and men in higher education and the labor force continues to be unequal. For instance, 48% of women study education, health and welfare or humanities and arts compared with 25% of men. Approximately 27% of women work in education, health and social work compared to 7 per cent of men (EIGE, 2022).

Eurostat data (2021) showed the number of female graduate students in science, mathematics, computing, engineering, manufacturing, and construction aged 20-29 in 2021. According to the figures, only 14.8 out of 1,000 Italian female graduates have STEM degrees, while 21.5 out of 1,000 male graduates have gained the same qualification. Thus, the female students in STEM

comprised approximately 40% of all the learners (Figure 2).

As is indicated by Figure 2, within the EU countries presented, the overall percentage of Italian students aged 20-29 pursuing STEM majors is relatively modest. The proportion of female students engaged in STEM aligns with the average percentage of female students pursuing STEM across the EU. In contrast, the percentage of male students pursuing STEM is apparently low. As illustrated in the data in Figure 2，21.5 out of every 1,000 male students aged 20-29 opted for STEM studies, a figure surpassed only the proportion of male students pursuing STEM in Poland in 2021.

Figure 2. Graduates in Tertiary Education (ED5-8), in Science, Mathematics, Computing, Engineering, Manufacturing and Construction by Sex - per 1000 of the Population Aged 20-29 in 2021
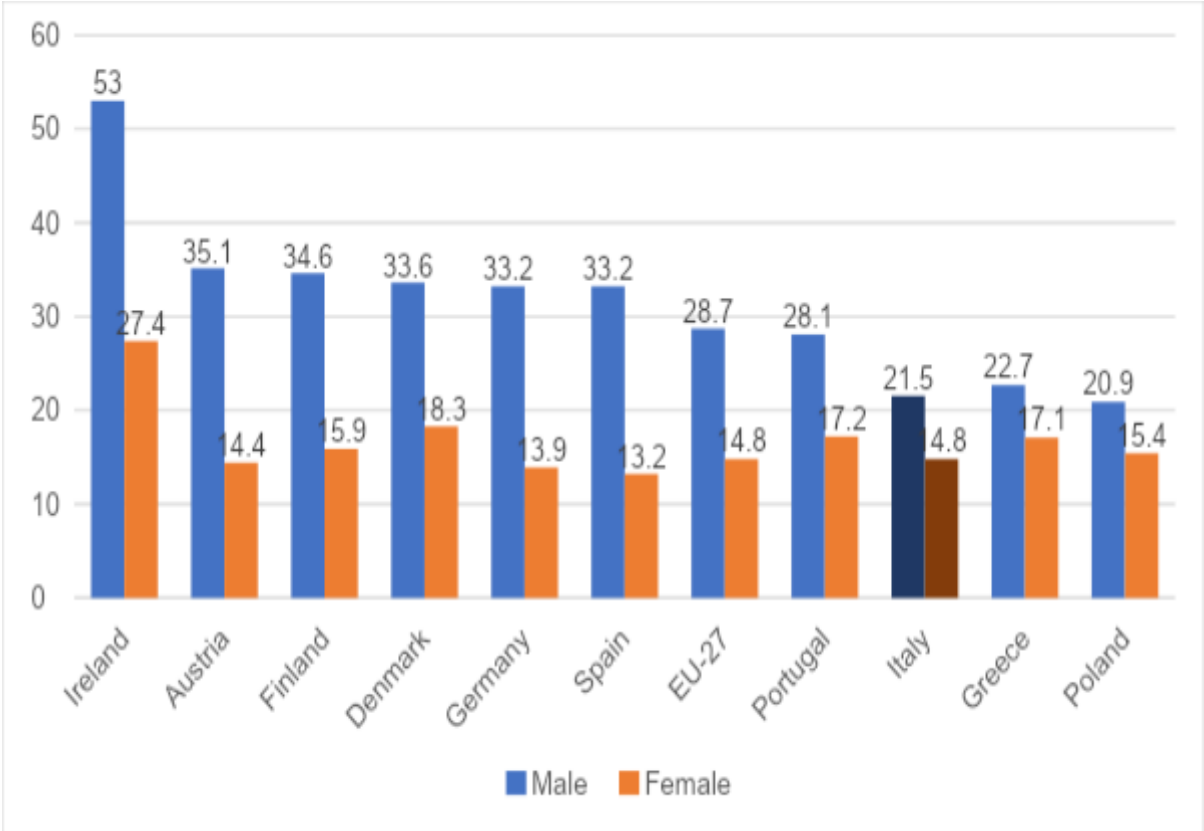
Source: *Eurostat data.（online data code: EDUC_UOE_GRAD04). Data extracted on Aug-17, last updated on 26/06/2023 23:00*

According to Figure 3, the amount of Italian graduates in tertiary Education (ED5-8) in science, mathematics, computing, engineering, manufacturing and construction has changed only slightly and shows an upward trend. The figure also shows the two lines representing male and female students trending away from each other. The ratio of males to females in 2013 and 2021 amounts to 1.41 and 1.45, respectively. Such findings indicate that the STEM gender gap in Italy continues to increase.

Figure 3. Graduates in Tertiary Education (ED5-8), in Science, Mathematics, Computing, Engineering, Manufacturing and Construction by Sex - per 1000 of the Population Aged 20-29 in Italy
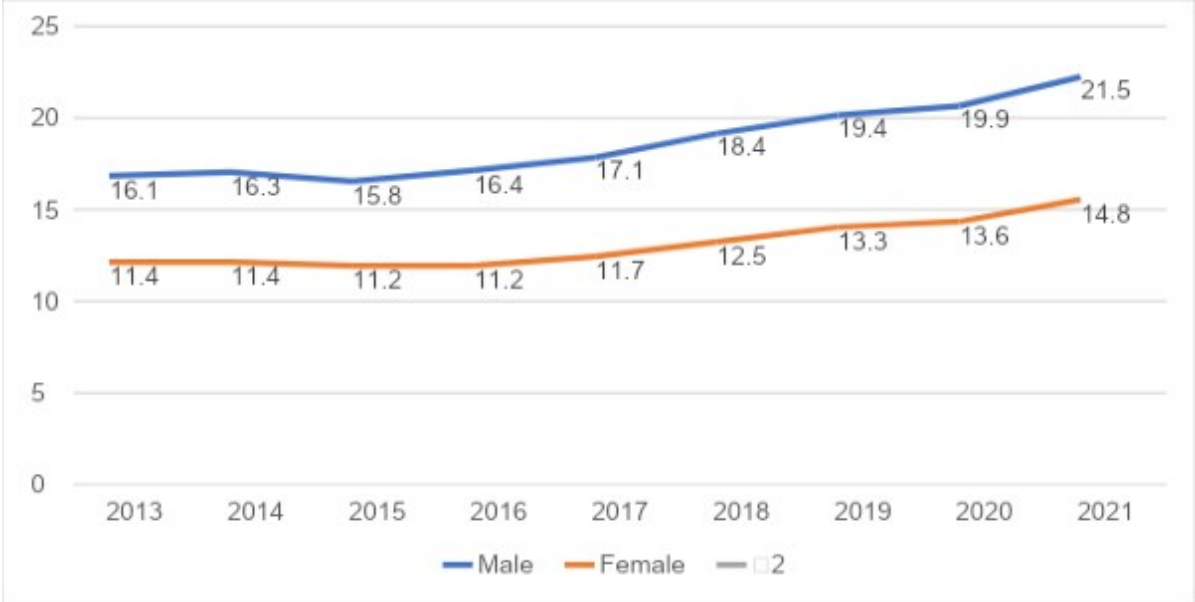
Source: Eurostat data. (online data code: EDUC_UOE_GRAD04). Data extracted on Aug-17, last updated on 26/06/2023 23:00

According to Figure 4, which shows the gender percentage of STEM graduates per 1000 of the population aged 20-29 in Tertiary Education of International Standard Classification of Education Levels 5, 6, 7 and 8 in Italy in 2021, the male-to-female ratio values of the four levels of higher education, ED-5, ED-6, ED-7 and ED-8, respectively stand at 4, 1.53, 1.31 and 1.33. The increase in academic attainment does not mean the number of women in STEM fields in Italian higher education has also decrease. The proportion of women taking part in STEM master's and doctoral programmes is higher than in undergraduate years, which fail to indicate

a leak between graduates and undergraduates. The proportion of women in master's and doctoral students declined little which is also not as the leaking pine-line describes. Instead, the proportion of female master's and doctoral students remained all most the same.

Figure 4. Gender Percentage of STEM Graduates per 1000 of the Population Aged 20-29 in Tertiary Education of International Standard Classification of Education Levels 5, 6, 7 and 8 in Italy in 2021
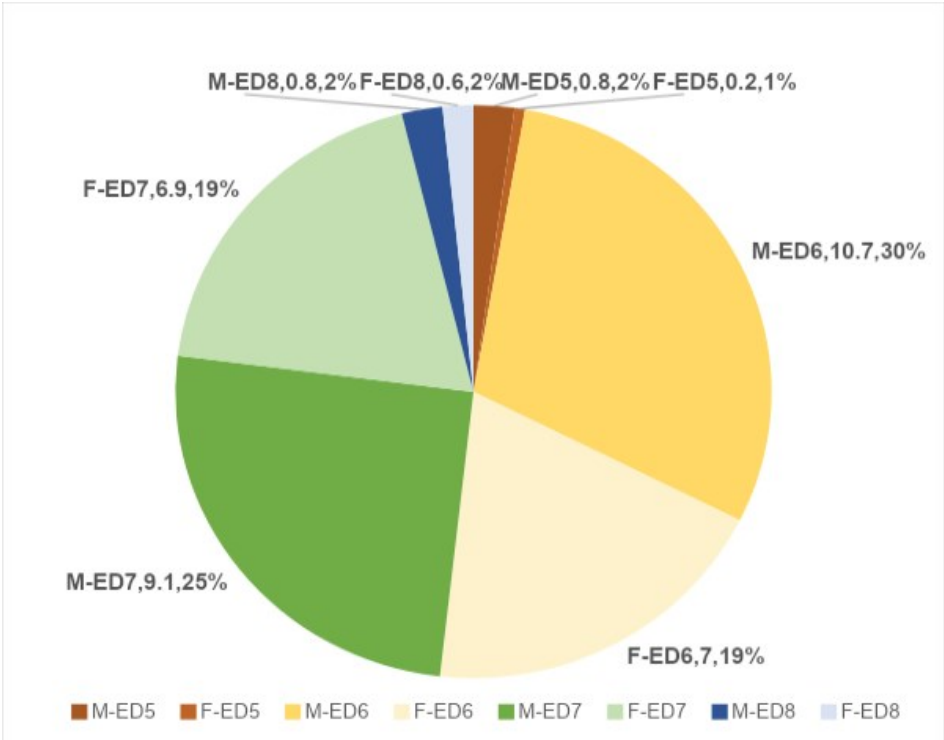
Interpretation of the diagram legend: M-ED5, 0.8, 2%=Gender-Higher Education Level, Number of STEM Graduates per 1000, Percentage of STEM Graduates M-Male, F-Female, ED-International Standard Classification of Education (ISCED), ED5--International Standard Classification of Education Level 5

Source: Eurostat data. (Online data code: EDUC_UOE_GRAD04). Data extracted on Aug-17, last updated on 26/06/2023 23:00

Although Figure 4 shows an apparently stable proportion of female students studying physics, biology, mathematics and engineering between 2013 and 2019, a closer look at the data reveals subtle changes. The number of students majoring in engineering and related sciences has decreased through the years, although the performance remains unclear, and the proportion has hardly changed. Evidence indicates that the number of women studying biological and related

sciences tends to exceed 70%. The proportion of students studying physics and related sciences is rising, while the proportion of females studying mathematics and related sciences is falling. The number of women enrolled in engineering and mathematics has decreased while, according to the total STEM landscape, the gender gap is increasing. However, other fields showed a decreasing gender gap. It becomes apparent that various STEM disciplines exhibit distinct characteristics, necessitating careful consideration by the respective disciplines.

The factors contributing to the varying gender patterns among different STEM subjects in Italy are remained to be examined. It is worth mentioning that the comparison conducted by the Hypatia project, which analyzes the different female ratios of Italian and Danish students in the field of physics, showed that while a background in the classical languages represents a valid qualification for studying physics in Italy, more women study physics than in Denmark, where physics students must have a background in mathematics (Achiam & Holmegaard, 2015). The transition of male student and female student from high school to college in STEM subjects deserves attention.

Figure 5. Percentage of female students in each STEM field (ED-6) in Italy (2013-2019)
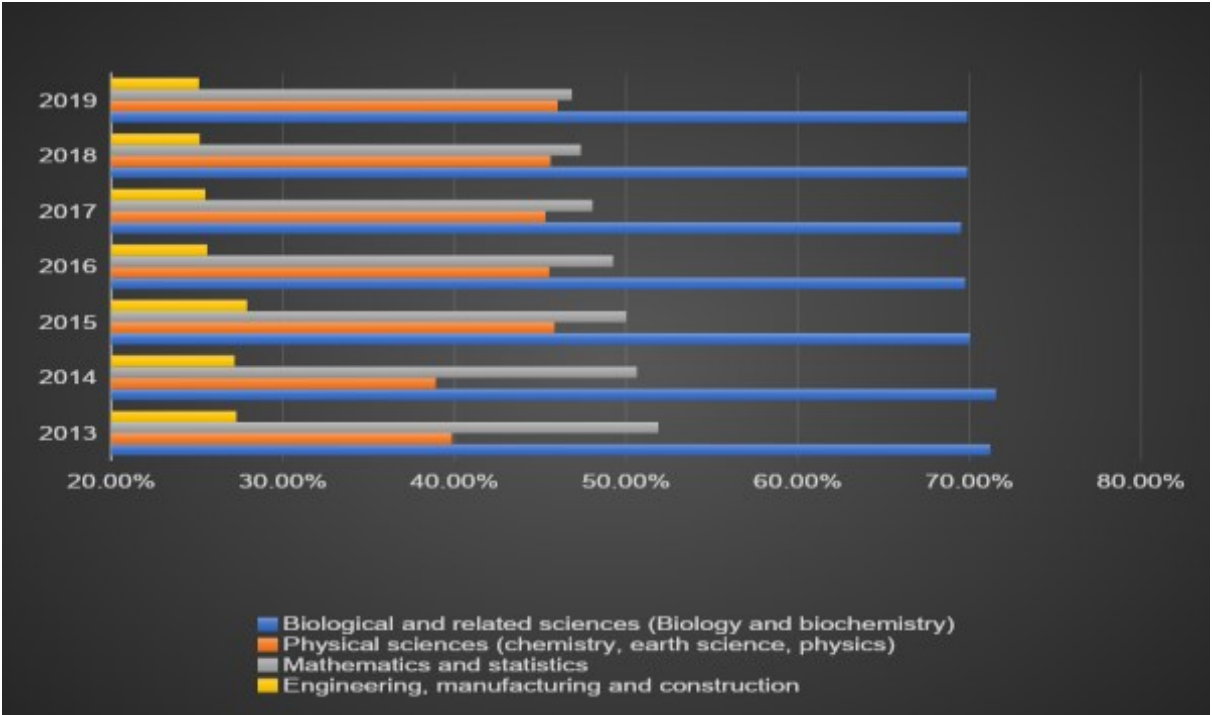
Source: Eurostat. (online data code: EDUC_UOE_GRAD04). Data extracted on Aug-17, last updated on

According to the division of ISCED fields of education and training (ISCED-F 2013), the first stage of a major can split into fields of education; arts and humanities, social sciences, journalism and information; business, administration and law; natural sciences, mathematics and statistics; information and communication technologies (ICTs); engineering, manufacturing and construction; agriculture, forestry, fisheries and veterinary; health and welfare; and services. According to Eurostat Stata and OECD Education statistics on graduates in tertiary education in Italy in 2020, an even split exists in natural sciences, mathematics and statistics, while the fields of education, health and welfare have the highest proportion of female students (Figure 6). Additionally, a notable gender gap exists in information and communication technologies (ICTs) and engineering, manufacturing and construction (Figure 6). The above information indicates that the proportion of female students studying diverse STEM in Italy has changed little since 2013, which suggests difficulties in implementing changes in these fields.

Figure 6. Male-to-female ratio by profession in Italian higher education (ED5-8) in 2020
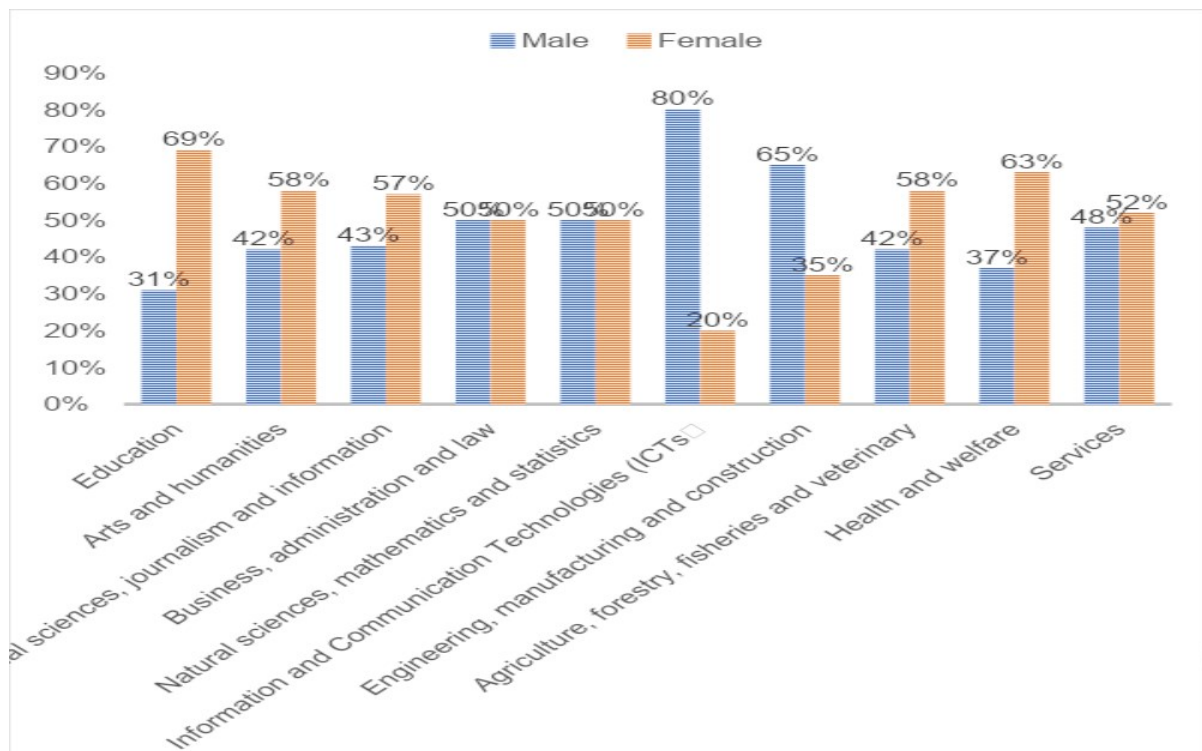
Source: *OECD Education statistics, the statistics on graduates and entrants by field. Share of graduates by*

Additionally, according to Almalaurea data on graduate profiles (2019a), the average final grade for women stood at 103.5 out of 110, compared to 101.6 for males, and 53.1% of women graduated on time. The subjects with the highest proportion of parental learners are industrial and information engineering (37.2%) and law (38.6%) (Figure 6). In contrast, parents of graduates in the education and training, language, sport and physical education subject groups are less educated. Thus, Italian students' choice of major reflects their parents' education level, and the children of parents with higher education levels often prove more likely to pick STEM as their major. Additionally, the pay gap between men and women remains wide, with male STEM graduates earning €1,699 a month after five years, compared to €1,375 for women (Almalaurea, 2019b).

Figure 7. Graduates of the year 2021 in Italy: education of parents by subject group (percentages)
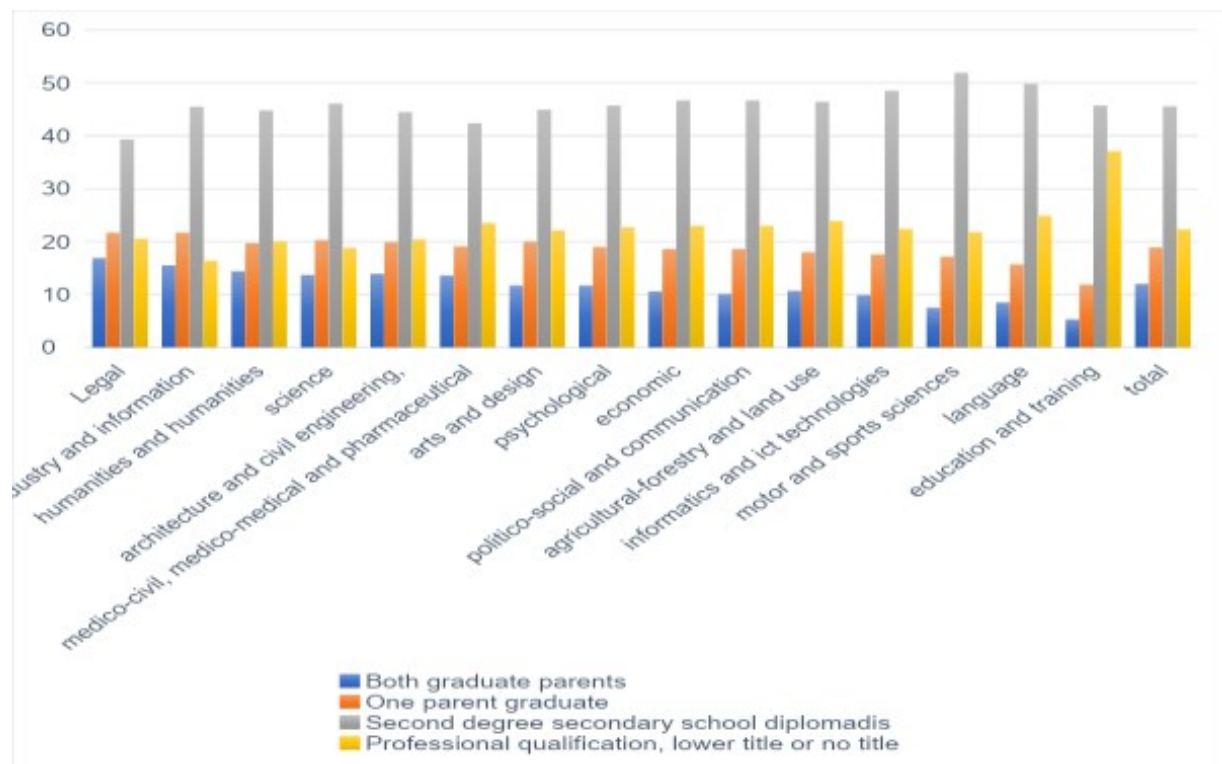
***Source:** Almalaurea. (2019a)*

3.1.2 Female STEM Students in China: Gender Segregation and SM Progress Dilemma

According to the World Economic Forum's (WEF) Global Gender Gap Report 2022, China ranked 102nd out of 146 countries (WEF, 2022). The share of women among new tertiary education (including ED5-8) entrants stood at 52.4% in 2020, resulting in a ranking of 30/38 of OECD and partner countries, which is one of the smallest in state of gender equality with the available data (OECD, 2022). However, since there are 34.9 million more men than women in China, according to the latest data from the Seventh Census of the National Bureau of Statistics of China (NBSC, 2023), the percentage of women attending higher education should be somewhat higher in fact. According to data issued by China's Ministry of Education (MOEC), when only the proportion of female students among undergraduate students (ED-6) is calculated, the number of female students enrolled in 2022 stood at 271,368, accounting for 61% (MOEC, 2022). As is indicated the number of female graduate students in higher education reached 1.599 million, accounting for 50.9% of all graduate students by 2020 (NBSC, 2021) (Figure 8).

Figure 8. The number and proportion of female graduate students in China from 2010 to 2020
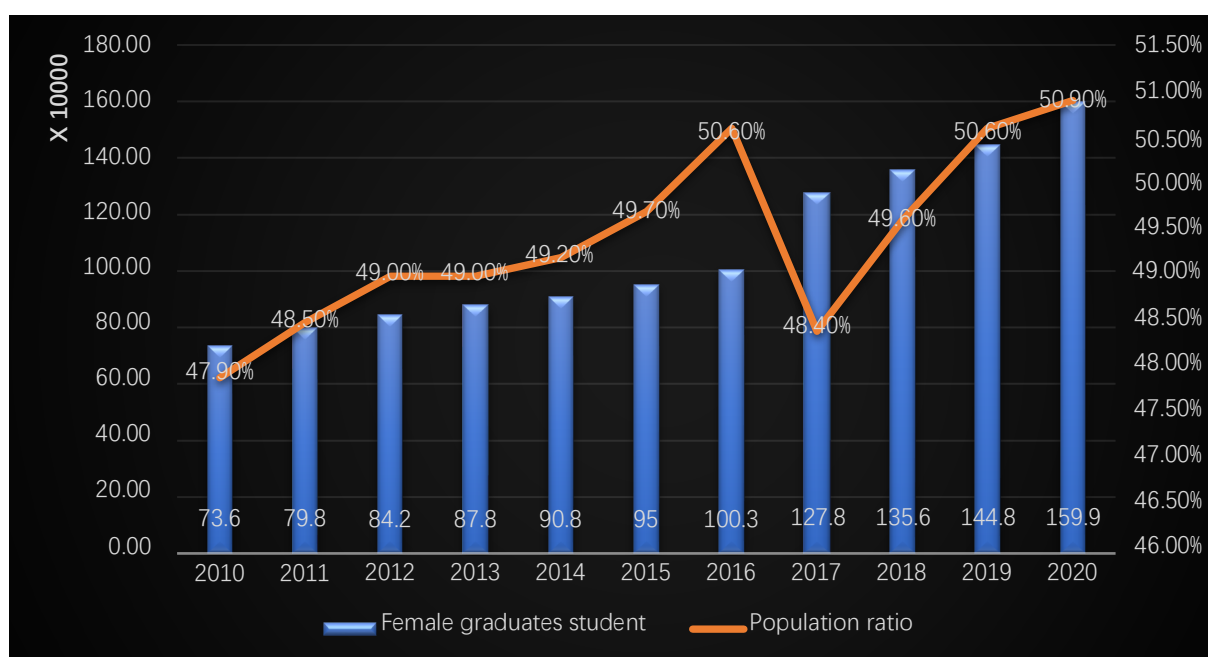
From 2008 to 2017, the ratio of male and female researchers with professional titles in China ranged from 3.92 to 5.47, that of associate professional titles ranged from 1.83 to 2.35, and that of intermediate professional titles ranged from 1.55 to 1.94. In other words, the more advanced the professional title level, the more pronounced the gender difference (NSLCAS & Elsevier, 2022).

According to the Catalogue of Undergraduate Majors in Colleges and Universities issued by the Ministry of Education of China, undergraduate majors comprise 12 disciplines, of which four are natural sciences, engineering, medicine and agriculture. There are eight humanities and social sciences: literature, history, philosophy, economics, management, law, education and art, also subdivided into professional categories, and under the subdivision of professional categories is the professional name. The STEM fields include science, engineering and agronomy. Since the higher education information issued by the Ministry of Education of China does not publish the number and proportion of female students in each major, this study seeks to utilize suitable information about the gender ratio of each STEM major from China's unofficial education database.

Statistical reference data from the College Entrance Examination in the Palm Website (CEEP) shows that people's choice of major depends on where they enroll and the college entrance examination. In terms of science and engineering, the gender gap between engineering majors exceeds the gap between science majors. According to the statistical data of CEEP, under the second professional classification category, namely, mathematics, chemistry, geographical science, atmospheric science, marine science, biological science, chemistry and pharmaceutical, textile, biological engineering, environmental science and engineering, food science and engineering, architecture and light industry, the male-to-female ratio does not differ significantly (CEEP, 2023). Most of these subjects fall under the STEM disciplines of science

and mathematics. However, in engineering majors, the gender ratio remains particularly wide, such as in mechanics, machinery, aerospace and transportation. In some majors, such as aircraft power engineering, marine electronic and electrical engineering, marine engineering and other disciplines, the proportion of women amounts to less than 10%. The first major name under the professional category is often the theoretical discipline of the major, and the ratio of men to women in the discipline tends to be the largest proportion of women in the professional category, while the ratio of women in the technical and practical name of the discipline is lower than the theoretical discipline. Among these disciplines are mathematics and applied mathematics, chemistry, geographical sciences, atmospheric sciences, palaeontology, biological sciences, biotechnology, ecology, pharmaceutical engineering, environmental engineering, environmental science, all food engineering and environmental majors, gemstones and materials technology, pharmaceutical engineering, most textile majors, biopharmaceuticals, landscape architecture, historic building conservation engineering and other fields of study. In packaging engineering and other majors, the proportion of females exceeds the proportion of males. According to the College Entrance Examination in the Palm Website (CEEP, 2023), the ratio of male students to female students in geography science and mathematics and applied mathematics majors stands at 31:69, and the ratio of male students to female students in mathematics and applied mathematics majors stands at 37:63. Analysing each subject as a unit helps indicate the process behind women's choice of major. Figures show that the ratio of females in mathematics and applied mathematics has reversed significantly. The ratio of women in mathematical computing science and information computing science under mathematics stands at 78:22 and 61:39, respectively, compared with 37:63 in mathematics and applied mathematics. Additionally, the findings of PISA 2015 showed that females in mainland China living in cities achieve the same level of mathematics performance as males (OECD, 2015). In China, the citizens are separated into urban household registration (cities) and rural household registration (villages), and a large gap exists between the average income of urban and rural residents. In 2021, urban residents' per capita disposable income reached 47,412 yuan, and that of rural residents stood at 18,931 yuan (UBSC, 2022). Studies have found that a student's

mathematics performance levels tend to influence the choice of STEM, which can help explain the reverse of gender in mathematics and applied mathematics. Additionally, the gender reversal in mathematics and applied mathematics did not mean more females became researchers in those subjects. According to the Gender in the China Research Arena report by the National science library, the Chinese academy of sciences (NSLCAS) and Elsevier, female mathematics researchers accounted for 25% of that of male mathematics researchers (NSLCAS & Elsevier, 2022). However, in the area of life sciences, such as chemistry, environmental studies and biochemistry, the ratio of female researchers to male researchers is approximately one-third. The mathematics field has shown a more significant gender leakage on the basis of the statistics available.

According to the UNESCO China Science Report, China plays an active role in the field of science, trains a large number of science students and researchers, and aids scientific development and the realization of Sustainable Development Goals (Lewis et al., 2021). The UNESCO Science Report of China shows that China remains active in the science field, raises a great deal of science students and researchers and occupies a significant place in the science development and SDG goals achievement. The number of university students continues to rise yearly (Lewis et al., 2021). Undergraduates from general institutions of higher education in China grew from 6809 in thousands to 7533 in thousands, and the total number of postgraduates rose from 552 in thousands in 2015 to 604 in thousands in 2018 (Lewis et al., 2021). Scientific publishing in China grew from 341561 in 2011 to 644655 in 2019, and the relative citations for China in 2014–2016 amounted to 0.98, while the G20 average stood at 1.02. China's publication output accounted for 14% of the global total in health sciences in 2019, up from 8% in 2011 (Lewis et al., 2021). Scientists in China have also published a notable amount on SDG-related topics (Lewis et al., 2021). China has a large pool of high-quality talent, which raises a crucial question of gender equality in science. According to the report published by Georgetown University's Center for Security and Emerging Technology, Chinese universities produced 49,498 students with STEM PhD degrees, compared to approximately 40,000 in America (Brief, 2021). If international students, who account for approximately 42%, are excluded from the

U.S. count, Chinese STEM PhD graduates would outnumber their U.S. counterparts by more than three to one (Brief, 2021).

Figure 9. The Gender Ratio in Science, Engineering, and Select Agronomy Disciplines

CATEGORY	DISCIPLINE CATEGORY	DISCIPLINE	RATIO
Science	Mathematics category	Mathematics and Applied Mathematics	37:63
		Information and Computing Science	61:39
		Basic Science of Mathematics and Science	78:22
	Physics category	Physics	56:44
		Applied Physics	77:23
		Nuclear Physics	88:12
		Acoustics	77:23
	Chemistry category	Chemistry	34:66
		Applied Chemistry	56:44
		Chemical Biology	47:53
		Molecular Science and Engineering	56:44
	Astronomy category	Astronomy	80:20
	Geographical Sciences category	Geographical Sciences	31:69
		Physical Geography and Resource Environment	47:53
		Human Geography and Urban and Rural Planning	45:55
		Geographic Information Science	53:47
	Atmospheric Sciences category	Atmospheric Sciences	48:52
		Applied Meteorology	50:50
	Marine Science category	Marine Sciences	55:45
		Marine Technology	64:36
		Marine Resources and Environment	55:45
		Military Oceanography	--
	Geophysics category	Geophysics	77:23
		Space Science and Technology	78:22
		Science and Engineering for Earthquake Prevention and Disaster Reduction	--
		Planetary Science	--
	Geology category	Geology	74:26
		Geochemistry	72:28
		Geo-Information Science and Technology	66:34
		Palaeontology	31:69
	Biological Sciences category	Biological Sciences	29:71
		Biotechnology	47:53

		Bioinformatics	53:47
		Ecology	43:57
		Integrative Science	--
	Psychology category	Psychology	22:78
		Applied Psychology	28:72
	Statistics category	Statistics	33:67
		Applied Statistics	36:64
		Data Science	--
		Biometry	--
Engineering	Mechanics category	Theoretical and Applied Mechanics	84:16
		Engineering Mechanics	88:12
	Mechanical category	Mechanical Engineering	91:9
		Mechanical Design and Manufacturing is extremely automated	92:8
		Material Forming and Control Engineering	84:16
		Mechatronic Engineering	90:10
		Industrial Design	54:46
		Process Equipment and Control Engineering	86:14
		Vehicle Engineering	90:10
		Automotive Service Engineering	78:22
		Mechanical Process Technology	67:33
		MEMS Engineering	82:18
		Mechatronics Education	66:34
		Automotive Maintenance Engineering Education	74:26
		Intelligent Manufacturing Engineering	--
		Intelligent Vehicle Engineering	--
		Biomimetic Science and Engineering	--
		New Energy Vehicle Engineering	--
		Additive Manufacturing Engineering	--
		Intelligent Interaction Design	--
		Emergency Equipment Technology and Engineering	--
	Instrument category	Measurement and Control Technology and Instruments	76:24
		Precision Instruments	--
		IntelliSense Engineering	--
	Material category	Materials Science and Engineering	71:29
		Material Physics	75:25
		Materials Chemistry	63:37
		Metallurgical Engineering	89:11
		Metal Materials Engineering	80:20
		Inorganic Non-Metallic Materials Engineering	77:23

		Polymer Materials and Engineering	72:28
		Powder Materials Science and Engineering	74:28
		Gem and Material Technology	37:63
		Welding Technology and Engineering	92:8
		Functional Materials	66:34
		Nanotechnology and Materials	57:43
		New Energy Materials and Devices	78:22
		Materials Design Science and Engineering	--
		Composite Moulding Engineering	--
		Smart Materials and Structures	--
		Optoelectronic Information Materials and Devices	--
		Biomaterials	--
	Energy and Power category	Energy and Power Engineering	84:16
		Energy and Environmental Systems Engineering	71:29
		New Energy Science and Engineering	72:28
		Energy Storage Science and Engineering	--
		Energy Service Engineering	--
		Hydrogen Science Engineering	--
		Sustainable Energy	--
	Electrical category	Electrical Engineering and Its Automation	82:18
		Smart Grid Information Engineering	72:28
		Light Sources and Lighting	71:29
		Electrical Engineering and Intelligent Control	80:20
		Motors and Electrical Appliances are intelligent	--
		Cable Engineering	--
		Energy Internet Engineering	--
		Smart Energy Engineering	--
		Electric Transport Engineering	--
	Electronic Information category	Electronic Information Engineering	73:27
		Electronic Science and Technology	77:23
		Communication Engineering	66:34
		Microelectronics Science and Engineering	77:23
		Optoelectronic Information Science and Engineering	77:23
		Information Engineering	71:29
		Radio and Television Engineering	46:54
		Hydroacoustic Engineering	74:26
		Electronic Packaging Technology	78:22
		Integrated Circuit Design and Integrated Systems	84:16
		Medical Information Engineering	51:49
		Electromagnetic Fields and Wireless Technology	80:20
		Radio Wave Propagation With Antenna	74:26

		Electronic Information Science and Technology	68:32
		Telecommunications Engineering and Management	60:40
		Applied Electronic Technology Education	55:45
		Artificial Intelligence	70:30
		Marine Information Engineering	--
		Flexible Electronics	--
		Intelligent Measurement and Control Engineering	--
	Automation category	Automation	81:19
		Rail Transit Signalling and Control	67:33
		Robotics Engineering	--
		Postal Engineering	--
		Nuclear Power Technology and Control Engineering	--
		Intelligent Equipment and Systems	--
		Industrial Intelligence	--
		Intelligent Engineering and Creative Design	--
	Computer category	Computer Science and Technology	66:34
		Software	73:27
		Network Engineering	71:29
		Information Security	65:35
		Digital Media Technology	51:49
		Smart Science and Technology	73:27
		Spatial Information and Digital Technologies	63:37
		Electrical and Computer Engineering	79:21
		Data Security and Big Data Technology	--
		Cyberspace Security	--
		New Media Technology	--
		Film Production	---
		Confidential Technology	--
		Service Science and Engineering	--
		Virtual Reality Technology	--
		Blockchain Engineering	--
		Cryptography Science and Technology	--
	Civil Engineering category	Civil Engineering	87:13
		Built Environment and Energy Application Engineering	71:29
		Water Supply and Drainage Science and Engineering	71:29
		Building Electrical and Intelligence	82:18
		Urban Underground Space Engineering	83:17
		Road, Bridge and River Crossing Project	91:9
		Railway Engineering	--
		Smart Construction	--

		Civil, Hydraulic and Marine Engineering	--
		Civil, Hydraulic and Transportation Engineering	--
		Urban Water System Engineering	--
		Smart Construction and Smart Transportation	--
	Water Conservancy category	Water Conservancy and Hydropower Projects	79:21
		Hydrology and Water Resources Engineering	63:37
		Port Waterways and Coastal Engineering	82:18
		Water Engineering	76:24
		Water Science and Engineering	--
		Smart Water Conservancy	--
	Surveying and Mapping category	Surveying and Mapping Engineering	79:21
		Remote Sensing Science and Technology	66:34
		Navigation Project	63:37
		Geographical Monitoring	58:42
		Geospatial Information Engineering	--
	Chemistry and Pharmaceuticals category	Chemical Engineering and Process	65:35
		Pharmaceutical Engineering	43:57
		Resource Recycling Science and Engineering	58:42
		Energy Chemical Engineering	73:27
		Chemical Engineering and Industrial Bioengineering	70:30
		Chemical Safety Engineering	--
		Paint Engineering	--
		Fine Chemicals	--
	Geology category	Geological Engineering	87:13
		Exploration Technology and Engineering	86:14
		Resource Exploration Engineering	83:17
		Groundwater Science and Engineering	69:31
		Tourism Geoscience and Planning Engineering	--
		Smart Earth Exploration	--
		Resource and Environmental Big Data Engineering	--
	Mining category	Mining Engineering	99:1
		Petroleum Engineering	81:19
		Mineral Processing Engineering	87:13
		Oil and Gas Storage and Transportation Engineering	71:29
		Mineral Resources Engineering	87:13
		Offshore Oil and Gas Engineering	85:15
		Smart Mining Engineering	--
		Carbon Storage Science and Engineering	--
	Textile category	Textile Engineering	45:55
		Fashion Design and Engineering	25:75
		Nonwoven Materials and Engineering	64:36

		Fashion Design and Craft Education	15:85
		Silk Design and Engineering	--
	Bioengineering category	Bioengineering	54:46
		Biopharmaceuticals	41:59
	Environmental Science and Engineering category	Environmental Engineering	54:46
		Environmental Science	46:54
		Environmental Ecological Engineering	49:51
		Environmental Protection Equipment Engineering	65:35
		Resource and Environmental Science	54:46
		Water Quality Science and Technology	67:33
	Food Science and Engineering category	Food Science and Engineering	38:62
		Food Quality and Safety	32:68
		Food Engineering	48:52
		Dairy Engineering	44:56
		Winemaking Engineering	44:56
		Grape and Wine Engineering	39:61
		Food Nutrition and Inspection Education	21:79
		Culinary and Nutritional Education	31:69
		Food Safety and Testing	--
		Food Nutrition and Health	--
	Architectural category	Architecture	62:38
		Urban and Rural Planning	52:48
		Landscape Architecture	36:64
		Historic Building Preservation Works	39:61
	Light Industry category	Light Chemical Engineering	63:37
		Packaging Engineering	49:51
		Printing Engineering	55:45
		Fragrance Technology and Engineering	--
	Transportation category	Transportation	69:31
		Traffic Engineering	75:25
		Nautical Technology	98:2
		Marine Engineering	98:2
		Flight Technology	100:0
		Traffic Equipment and Control Engineering	75:25
		Rescue and Salvage Projects	100:0
		Marine Electrical and Electronic Engineering	93:7
		Rail Transit Electricity and Control	--
	Marine Engineering category	Marine and Offshore Engineering	86:14
		Marine Engineering and Technology	88:12
		Marine Resources Development Technology	58:42
		Marine Robot	--

		Smart Ocean Technology	--
	Aerospace category	Aerospace Engineering	82:18
		Aircraft Design and Engineering	86:14
		Aircraft Manufacturing Engineering	90:10
		Aircraft Power Engineering	92:8
		Aircraft Environment and Life Support Engineering	71:29
		Aircraft Quality and Reliability	71:29
		Aircraft Airworthiness Technology	67:33
	Agricultural Engineering category	Agricultural Engineering	62:38
		Agricultural Mechanisation and Its Automation	87:13
		Electrification of Agriculture	74:26
		Agriculture, Architecture, Environment and Energy Engineering	71:29
		Agricultural Water Conservancy Engineering	71:29
		Land Consolidation Works	--
Agronomy	Plant Production category	Agronomy	54:47
		Horticulture	37:63
		Plant Protection	46:54
		Plant Science and Technology	52:48
		Seed Science and Engineering	53:47
		Facilities Agricultural Science and Engineering	64:36
		Tea Science	36:64
		Tobacco	61:39
		Applied Biological Sciences	43:57
		Agronomic Education	43:57
		Horticultural Education	23:77
	Nature Conservation and Environmental Ecology	Agricultural Resources and Environment	54:46
		Wildlife and Nature Reserve Management	45:55
		Soil and Water Conservation and Desertification Control	60:40
		Biomass Science and Engineering	--

Source: College Entrance Examination in the Palm Website. (2023). Check professional. College Entrance Examination on the Palm Website(Zhangshanggaokao Website，https://m.gaokao.cn). China Teaching Wisdom Website (Zhongjiaozhiwang) (Beijing) Information Technology Co., LTD. Web. 25 September 2023 Retrieved from https://www.gaokao.cn/special?fromcoop=pddh

3.2 Historical, Social and Political Context of Gender Equality in STEM Higher Education in Italy and China

3.2.1 Historical, Social and Political Context of Gender Equality in STEM Higher Education in Italy

In 1946, Italian women could vote for the first time, and the Constitution of the Italian Republic incorporated the principle of gender equality in Article 3 of its fundamental articles. However, in the two decades following that change, little action was taken to enforce the principle (Rosselli, 2014). Women comprised only a small minority in parliament. Both right- and left-wing political parties shared a "familism" ethos based on the notion that the traditional family formed the cornerstone of social order and the primary supplier of social protection (Lombardo & De Giorgio, 2013). Moreover, the Christian Democratic Party, the principal embodiment of political power from 1948 to 1994, adhered to the principles of the Catholic Church; the Communist Party, somewhat aligned with these values, also expressed concerns about losing consensus if it challenged the traditional gender roles of male breadwinners and female caregivers (Rosselli, 2014). The improved post-World World War II economic order showed that the income per capita more than tripled from 1947 to 1967 (Crainz, 2003). The boom years of the "economic miracle" (1958-1963) (Ballestrero, 1979), combined with the civil rights movement and women's movement at the end of the 60s, helped combat gender role stereotypes. In 1970, a law regulating divorce (Law No. 898/1970) received approval after several unsuccessful attempts. A law implemented in 1971 also prohibited the dismissal of pregnant women. In 1974, pro-divorce groups won nearly 60% of the votes in a referendum to repeal the law. This unexpected victory indicated that Italy had experienced significant changes, heralding a radical reform of family law in 1975 (Law 151/1975). This law offered legal equality between spouses, ending the male-dominated family hierarchy. In 1977, the Italian Parliament passed a law on equal treatment between working women and men. However, a significant gap has appeared between the progress of women's rights and their representation in law.

Statistics from the World Bank (WB) showed that the female-to-male labour force participation ratio (national estimate) in Italy grew from 44% to 69.6% (WB, 2021). In the mid-1980s, the proportion of girls in secondary education exceeded that of boys; since the 1990s, women have outnumbered men in higher education (Rosselli, 2014). In 1996, rape was no longer deemed a crime against public morals but a crime against individuals (Law No. 66/1996). In 2013, the authorities enacted two further pieces of legislation: Law 113/2013 against gender-based violence, femicide and violence against women and Decree 1200/2019 against revenge pornography and permanent mutilation of the face.

In the 1990s and early 2000s, progress on gender equality stemmed from the need to adopt EU directives (such as 97/80/CE on discrimination and 2002/73/CE on equality in employment) and the requirement to use European funds.

According to the 2019 study by the Italian National Institute of Statistics (ISTAT) on gender role stereotypes and statistics, gender stereotypes also play a key role. These findings buttress the view of women as subordinate to men, with such stereotypes remaining equally prevalent among males and females (ISTAT, 2019). In particular, the most popular belief among many people, most significantly among youths, is that personal success and fulfilment at work prove more important for men than women (ISTAT, 2019). Statistics showed that 32.5% of people agreed that "for the man, more than for the woman, it is very important to be successful at work". Additionally, 31.5% of interviewees stated that "men are less suited to do housework", and 27.9% of people supported the statement that "it is up to the man to provide for the family's financial needs" (ISTAT, 2019). The declaration that "it is up to the man to take the most important decisions about the family" received the lowest level of support: 8.8% (ISTAT, 2019). The stereotypes are more frequent in Southern Italy (67.8%), especially in Campania (71.6%) and in Sicily, and less often in the North-east (52.6%), with the lowest figures reported in Friuli Venezia Giulia (49.2%) (ISTAT, 2019).

Cieślak-Golonka and Morten (2000, p. 68) observed that "in approximately everywhere Europe, A university education was excluded women, with Italy as an exception". In 1876, Article 8 of the General University Regulation (Regolamento generale universitario) explicitly stated that

"Women can enrol into the register of students and auditors (uditori) when they provide the required documents or equivalent titles". However, until 1877, the Russian Ernestina Paper (1846–1926) obtained her medical degree in Florence. Despite the legal framework, only a few women initially registered. One main obstacle was the low proportion of women in secondary schools; many universities required this level of education as a prerequisite for entry (Dröscher, 2022). In 1881, Italy had its first two female graduates in the natural sciences. The first woman graduated from law in 1894. By 1900, 224 women had graduated in Italy, 48 of whom had chosen science departments: 25 in natural sciences, 19 in mathematics, two in physics and two in chemistry (Ravà, 1902; Dröscher, 2022). Another 22 women, from a total of 198 female graduates, received degrees in scientific disciplines between 1904 and 1911 (Govoni, 2006, 2009; Paoli, 2011; Dröscher, 2022). Science courses were always more popular than medical, judicial, agricultural, and engineering courses but not as popular as humanities courses (Cammelli & Di Francia, 1998, p. 34-38; Dröscher, 2022). The first female engineer graduated in 1908. The Reform Act of 1923, signed by Giovanni Gentile, played a crucial role in scientific education in Italy, especially for women (Govoni, 2009). His Education Act of 1923 raised the university fees for female learners (Dröscher, 2022). On the one hand, he supported the education of women and created institutions for them. However, he did not allow them to become faculty teachers in the subjects he considered most important, namely history, philosophy, Latin and Italian, which had a positive effect on the study of natural sciences. The number of women enrolled in university science courses increased and peaked in the early 1920s when the proportion of female students in the student body declined (Govoni, 2015, p. 79). In 1926, women comprised just over 14 percent of all graduates, and very few women completed college. They remained confined to certain faculties (literature and philosophy) and had few job prospects. Examples of this situation include Maria Montessori, who graduated in medicine in 1896 but worked as a teacher and educator; Lidia Poet, who graduated in law in 1881 and became a member of the bar and was barred from practising law after the Supreme Court annulled her registration because of her gender. The first female architect graduated in 1932. Italy had its first female police officer in 1952, its first female judge in 1964 and its first

female Ministry of State in 1976.

Gender inequality has long been an issue at Italian universities, and even now, these bodies are not recognized as gender-neutral institutions (Eddy & Ward, 2017). Gender segregation in universities (Cammelli & Di Francia, 1998, p. 34-38) means females can encounter challenges becoming university professors (Dröscher, 2022).

At one stage, many people considered academic careers distinguished and too demanding to balance family and work (Dröscher, 2022). A number of female university professors have given up their lives as wives and mothers, and scholars who never married have grown in number. Women with academic careers are expected to mirror how men work, forcing them to "sacrifice" their mothers and marriages for their careers. It wasn't until 1910 that Rina Monti was appointed a tenured professor at the University of Sassari (Govoni, 2009). However, her appointment meant she could increase her political lobbying (Droscher, 2022). She turned to renowned scientists such as Ernst Haeckel (1834-1919) and Gustav Rezius (1842-1919) for support (Droschel, 2007, pp. 139-141) and relied on her brother Achille (1863-1937), a professor of pathological anatomy and a powerful politician and whose circle could support her. On the one hand, they ignored her femininity and emphasised that she "works like a man". On the other hand, they thought people ignored her simply because she was a woman. In 1906, in the midst of a campaign to be appointed Chairman of Zoology at the Natural History Museum of Milan, Monti's mentor Pietro Pavesi wrote a letter praising her energy and innocence and assuring that "the care of her family will not distract her from her tireless activities" (Canadelli, 2008). Moti himself wrote a letter expressing the hope that Milan, "the most civilised city in Italy", would not object to the appointment of a woman (Canadelli, 2008, p.142, pp. 257-258). Shortly thereafter, the Minister of Education called Rina Monti to a chair at the University of Sassari. Furthermore, the University of Palermo did not appoint its first female dean until 1981. The University of Udine appointed a female rector for the first time in 2008. In 2018, only 23.7% of full professors in Italian universities were women, while the figures increased to 38.4% among associate professors and to 46.7% among assistant professors (Filandri & Pasqua, 2021).

3.2.2 Historical, Social and Political Context of Gender Equality in STEM Higher Education in China

Following the founding of the People's Republic of China, the 1954 Constitution, the country's first constitution, clarified the principle of gender equality and declared that women should enjoy equal rights with men in all aspects of political, economic, cultural, social and family life. The first enacted legislation was the Marriage Law, which was closely related to women's rights and interests. The law established the principles of free marriage, monogamy and equal rights for men and women, broke the bondage, oppression and destruction of women by the feudal marriage system, profoundly changed the fate of Chinese women and improved their status in marriage and family. Successive amendments to the Marriage Law reaffirmed the marriage system of equality between men and women and added provisions to protect women's rights and interests, such as the prohibition of domestic violence, the right to compensation for domestic work and compensation for divorce damages. The Law on the Protection of Women's Rights and Interests, the first special law of the People's Republic of China to safeguard women's rights and interests, was enacted in 1992 and revised in 2005. The law provides specific provisions on women's political rights, cultural and educational rights, labour and social security rights, property rights, personal rights, marriage and family rights and interests. In other words, this law emphasises that the state guarantees that women enjoy the same cultural and educational rights as men. Furthermore, the law's 2005 amendment stipulated that schools should provide access to education, including majors who may require specialised tuition. The law shall not refuse to admit women on the grounds of gender or raise the admission standards for women, which lays a legal basis for gender equity in higher education. In 1986, the state promulgated the Compulsory Education Law of the People's Republic of China, which requires nine years of compulsory education to provide a legal guarantee for girls' learning. The state has increased the amount of opportunities for rural girls to receive education by establishing grants for primary and secondary schools and support policies for girls, such as the Spring Bud Project and the Hope Project (Xiaoshi, 1995). In the 21st century, the integrated development of urban and rural compulsory education and improved education standards mean rural girls

have more opportunities to study. In 2017, the retention rate of nine-year compulsory education in China reached 93.8%, and the net enrolment rate of female primary school students stood at 99.9%, equal to that of male students (MEC, 2017). The promotion of gender equality in K12 education has also promoted similar equity in higher education.

In 2015, the authorities promulgated the Anti-Domestic Violence Law, providing a more thorough legal guarantee for solving the problem of domestic violence against women and maintaining equal, harmonious and civilised family relations. In the same year, Amendment (IX) to the Criminal Law abolished the crime of prostitution with underage girls and implemented severe punishments for crimes that violated the personal rights of underage girls. The General Provisions of the Civil Law and the Civil Code have all adhered to the principle of gender equity.

Following the founding of New China, women were given the same responsibility as men to build the country and develop the national economy. During the "Great Leap Forward" and "Going to the Countryside" periods, women undertook the same physical labour as men, and women's public social status received further recognition. However, women still had to look after children at home alongside their work duties.

In the early 1970s, the authorities in China gradually introduced the family planning policy to control rapid population growth. China's family planning policy is not solely a one-child policy. Since 1984, the policy has included the one-child policy, the one-and-a-half-child policy (i.e., if the first is a boy, labour stops; if the first child is a daughter, you can have a second child); the two-child policy and unlimited fertility. The one-child policy was introduced to the vast majority of urban and rural residents in Beijing, Tianjin, Shanghai, Jiangsu, Sichuan and Chongqing provinces (municipalities), which means that most one-child families have better economic conditions (Bongaarts & Greenhalgh, 1985; Li & Cooney, 1993; Potts, 2006). Until 2013, the Central Committee of the Communist Party of China (CPC) and its "Decision on Several Major Issues on Deepening Reform" implemented "the policy of having two children if one of the couple is an only child" and allowed the birth of two children by 2016. According to the 2017 China Social Situation Survey by the Institute of Sociology of the Chinese Academy

of Social Sciences, the proportion of only children among the post-60s and post-70s groups is extremely low (4.3% and 6.8%, respectively). The proportion of only children in the post-80s and post-90s groups shows a marked increase (19% and 32%, respectively), and the proportion of only children in the post-00s stands at more than 60% (NBSC, 2018a, 2018b). Varying family economic conditions and cultural concepts directly affect education. Women from all manner of social backgrounds have different opportunities to receive higher education (Fan, 2014). Girls from families with strong cultural capital and better economic conditions have more opportunities to attend school than girls from poor backgrounds (Fan, 2014). The one-child policy has benefited urban women and improved gender equality in higher education (Lingyu et al., 2021).

The Program for the Development of Chinese Women, issued in 1995, 2001 and 2011, has taken "women and education" as a priority area of action for women's development and has outlined a series of indicators such as enrollment rate, literacy rate and average years of schooling for measurement. The programme includes a focus on three key areas: national macro laws, sectoral policies and social education and training. Action measures range from strengthening legislation, policy formulation and improving curriculum content and methods to employing distance education resources. These policies and regulations have gradually focused more on gender equality in education. In 2011, China's development programme for women proposed to highlight the importance of gender equality in three areas: educational opportunities, educational processes and educational outcomes. Alongside seeking to improve women's educational opportunities, it also sought to increase substantive educational equity. In 2007, the Outline for the Construction of the National Women's Education and Training System emphasized "promoting equal access of men and women to social education resources and improving women's ability to participate in economic and social development".

According to research aided by the Second Phase of the Survey on the Social Status of Chinese Women (SSSCW), 50.4% of women agreed that men should prioritize society and women should prioritize the family (SSSCW, 2015). In the third survey of Chinese women's social status conducted by the All-China Women's Federation and National Bureau of Statistics of

China (ACWF & NBSC, 2011), the proportion agreeing with the statement "men should give priority to society, and women should give priority to the family" rose to 54.8 percent. However, the proportion of female college students agreeing with this statement stood at only 30.0%, far lower than the level of women in other areas of society (ACWF & NBSC, 2011). Women should focus on the family, "earning money to support the family is mainly a man's thing" and "caring for their husbands and teaching children is the most important job for women", so as to show a stronger willingness to pursue gender equality (ACWF & NBSC, 2011). According to the findings, 83.5% of the respondents agreed that "women are not less capable than men", 88.6% agreed that "men should also take the initiative to do housework" and 86.7% agreed that "gender equality will not be achieved automatically, and it needs to be actively promoted" (ACWF & NBSC, 2011). The proportion of men and women who agreed that "men should give priority to society and women should give priority to family" stood at 61.6 percent and 54.8 percent, respectively, up 7.7 and 4.4 percentage points from 2000 (ACWF & NBSC, 2011). Social stereotypes about gender roles have also risen. The proportion of female students with excellent academic performance reached 62.4%, 9.7 percentage points higher than that of male students. Female volunteers accounted for 64.5%, 4.8 percentage points higher than male volunteers. Moreover, 87.5% of girls hoped to make a difference in their work, and 83.8% showed a willingness to work hard to forge a career. Women's grades and ambitions do not differ from men's (ACWF & NBSC, 2011). According to the survey, 24.7 percent of female college students looking for work have encountered unequal treatment (ACWF & NBSC, 2011). The problem of unequal treatment of women in the workplace requires improvement. The proportion of female senior talents with a college degree or above accounted for 81.4%, 7.1 percentage points higher than that of men. Additionally, the findings have shown that 95.9% of female senior talents "can take the initiative to update knowledge and skills", 93.7% "can often communicate with colleagues and peers about work and professional ideas" and 79.1% "have a clear plan for their own development" (ACWF & NBSC, 2011). Females have exhibited high levels of education and work ability. In the fourth survey on the status of women, 94.1 percent of the respondents agreed with the statement that "women are not less capable than men", 10.6

percentage points higher than in 2010; 94.8 percent of the respondents agreed that "women have played half of the role in economic and social development" (FSSCW, 2022). According to the statistics, 95.4% of the respondents agreed that "gainful employment is important for women" (FSSCW, 2022). The proportion of men and women who disagreed with the statement that "men should give priority to society and women should give priority to the family" stood at 50.9 percent and 58.3 percent, respectively, an increase of 14 and 14.7 percentage points over 2010, among which 80 percent of women under the age of 35 disagreed. Moreover, 93.3 percent agreed that men should balance family and work (FSSCW, 2022). More than 80 percent of the respondents disagreed that "taking care of children is only the responsibility of the mother," including 94.6 percent of women under the age of 35. Approximately 70% of the respondents did not agree that "wives should obey their husbands at home", including 87.3% of women under the age of 35. The findings also show that 77.9 percent of women and 77.3 percent of men said science and engineering do not suit women (FSSCW, 2022).

Confucianism established fundamental notions of hierarchical relationships sustained by cultural and social practices to maintain the social order. In this way, the Confucian tradition constructed ways of fulfilling social roles (through socialization and upbringing), viewing women and men in terms of their social roles and the quality of their social relationships. Traditional social roles highlight the role of fathers and older brothers in their commitment to the welfare of family members, and women represent one of the groups to which men are obligated, without giving women the opportunity to form relationships or determine themselves (Wang, 2003). Gromkowska & Boro (2023) distinguished two kinds of independent discourse on the role of women in modern China. The first kind models the "neoliberal" woman with social roles and functions based on gender equality and equal responsibility for her destiny (Melosik & Boro, 2023). The second model refers to the traditional concept of women in China. According to Liu (2021), "Women feel the conflict between social and family roles. In the job market, when the competition for jobs is fierce, women are more or less faced with the potential pressure to return to the family. Well-educated (......) women feel conflicted between starting a family life and starting a career."

Culture profoundly affects an individual's way of life and thinking, as well as teachers' learning or instruction methods. Confucius, the representative of Confucian educational thought, believed that a person gains knowledge through diligent study (Sun, 2013; Hui, 2005). In other words, the ability of individuals is not innate but acquired through training and teaching (Tan & Ibrahim, 2017; Yuhan & Chen, 2013). Society believes that a person's success depends mainly on effort or diligence, and an individual's genetic factors play a secondary role (Leung & Nann, 1995; Cheng & Wong, 1996). The old sayings "Heaven rewards diligence" and "diligence can compensate for stupidity" have been shared throughout Chinese history, and parents and teachers often use it to motivate children to study harder (Cheng & Wong, 1996; Dodgen, 2001). This saying contributes to the formation of a new impression that Chinese people are good at mathematics (Cvencek et al., 2015; Wang & Li, 2014). Regardless of their application to males or females, such motivational phrases can help remove the restrictive stereotypes related to learning achievement.

China's first public girls' school was established in 1898. After the founding of the Republic of China in 1912, the primary school was co-educational. Before 1919, several higher education institutions run by Western missionaries would admit women. These institutions included Yenching Women's University in Beijing (1908), South China Women's University in Fuzhou (1914) and Nanjing Jinling Women's University (1915). In 1919, Beijing Women's Higher Normal School was established, becoming China's first formal institution of higher education for women (Bailey, 2007).

In 1919, the Ministry of Education of the Provisional Government of the Republic of China promulgated the Regulations on Women's Higher Normal Education, implementing a system for women to receive higher education. In the spring of 1920, Peking University started admitting female students, prompting other universities to do the same. In 1922, the school system was updated: at all levels of study, from primary school to university, a male and female division in the curriculum was no longer in place. Thus, Chinese women acquired equal education rights and equity with men. In 1947, the number of college students in China amounted to 155,036, of which 27,604 were female, accounting for 17.8% (Editorial Board of

Education Yearbook, Ministry of Education, 1948). The lack of economic resources to develop STEM means the humanities and social sciences dominated the discipline structure of higher education in the Republic of China. Between 1947 and 1948, the total proportion of college students majoring in engineering, science, agriculture, forestry and medicine stood at 38.46% (Ministry of Higher Education of the People's Republic of China, 1956, p. 7).

Since the founding of the People's Republic of China, significant changes have occurred in women's acceptance into STEM higher education programmes. On the one hand, the 1954 Constitution stipulated the equal rights of men and women to receive education, laying a legal foundation for the development of women's higher education. At the same time, the central government restructured existing higher education institutions, integrating women's colleges into regular higher education institutions and introducing universal co-education. The introduction of the college entrance examination system and the people's financial support system have removed the institutional and economic obstacles for women to receive higher education. Women can now obtain university places through objective exams, meaning they avoid potential sexism in interviews. For women from poorer economic backgrounds, the people's financial assistance also effectively ensures they do not drop out of school for economic reasons. The People's Republic of China has promoted industrial modernization and, therefore, attaches great importance to STEM. From 1951 to 1952, the proportion of college students in science and engineering, agriculture and medicine rapidly increased to 58.46%, of which engineering received special attention and reached 38.1% in 1955 (UNESCO & BJU, 2007). Additionally, in terms of ideology, the government vigorously propagated women's liberation slogans, such as "men and women stand side-by-side in the revolution" and "women hold up half the sky" so that awareness of gender equality has become the mainstream cultural belief throughout society (Wu, 2009; Li, 2013). The status of women improved in the early days of the Communist Party of China (CCP) (Ma, 2017). Influenced by national policies at the time, the proportion of female students in the higher education system peaked in 1954 and 1974. In 1954, the number of female learners among university students increased to 26.27% (Ministry of Higher Education, 1956, p. 19). Given this political and historical background, the

development of women's higher education at this stage proved tortuous, but, on the whole, it experienced an increase. The idea of prioritizing STEM to serve the national strategy that laid the foundation for this period continues to this day.

China's higher education system has progressed significantly since the college entrance examination system's restoration in 1978. According to the Statistical Yearbook of China's Educational Undertakings 1999, the number of higher education institutions in China increased from 201 in 1952 to 1,071 in 1999, and the enrolment of female students increased from 79,000 in 1952 to 1,678 million in 1999 (MEC,1999) (Table 13). The increase in the number of higher education schools and the expansion of the enrolment scale have also played a positive role in the acceptance of Chinese women into higher education.

Table 13. The Proportion of Female Students in Chinese Colleges and Universities from 1947 to 1999 (%)

1947	1955	1960	1965	1975	1980	1985	1990	1995	1999
17.8	25.9	24.5	26.9	32.6	23.6	30.0	33.7	38.5	39.7

Source: China Educational Statistical Yearbook, 1999

In 2009, the number of female students in colleges and universities exceeded the number of male students for the first time. The prominence of women in higher education indicates the wider distribution of educational opportunities and higher academic standards. However, from the perspective of educational outcomes, women still face many challenges in the labour market and postgraduate education.

From 2002 to 2021, the gross enrolment rate of China's higher education increased from 15 percent to 57.8 percent in 2021, illustrating the structural transformation of higher education from mass to universal. Figures show that women's enrolment in higher education has increasingly overtaken that of men. In 1980, there were 268,000 female students and 876,000 male students in higher education in China. In 2009, the numbers rose to 10.82 million female students and 10.62 million male students in Chinese schools. These figures show the number of female students in institutions of higher learning exceeded that of male students for the first time. In 2021, there were 27.8 million female students and 27.5 million male students in

universities and colleges in China (MEPRC, 1980, 2010, 2021). However, despite this change, gender segregation in different majors remains evident: females tend to focus on languages, education and other subjects, and males concentrate on science and engineering.

3.3 Thematic Analysis of STEM Higher Education Gender Equality Policies in Italy and China: A Comprehensive Examination

3.3.1 Vision: Is Policy Guided by a Clear Vision that Increases Quality and Equity for All Learners through Inclusive Education?

With regard to the Chinese policies, it is worth explaining that since China does not consider STEM as a theme in its policies, the policies it has formulated, such as on developing female scientific and technological talents, are China's strategy for the development of female STEM talents. Through the policy background mentioned in the policy whereby 'women are engaged in basic theories, applied technologies and engineering practices' and 'The goal is to support women to advance in the breadth and depth of science and technology', with the content involving the talents in the various projects of the National Natural Science Foundation(Chinese National Foundation projects are divided into two types of projects, namely those of the National Natural Science Foundation and the National Social Science Foundation which represent). 'Strengthen the career planning guidance of female university students in science and technology' and other policy contents are also reflected. Policy is centred around the development of women in STEM fields, as targeted by this study.

Chinese policies related to gender equality in STEM in higher education:

- National Human Rights Action Plan (2021-2025) (Policy 1)
- Outline for the Development of Chinese Women (2021-2030) (Policy 2)
- Several Measures to Support Female Scientific and Technological Talents to Play a Greater Role in Scientific and Technological Innovation (Policy 3)
- Opinions on the Implementation of Women's Actions in Science and Technology

Innovation (Policy 4)

● China's Education Modernisation (Policy 5)

There are three themes that can be recognized, which are development, equality and value, quality education.

Table 14. Mapping Themes of Vision of Gender Equality Policies in STEM HE in China

POLICY TEXT	SUB-THEME	MAIN THEME
Strengthen equal protection and special assistance for the rights and interests of specific groups, promote equal sharing of the fruits of development by all (policy 1)	Equal protection for all and special assistance of specific groups	Value，Equality
provide policy support for achieving comprehensive development for all (policy 1)	Free and comprehensive development for all	Development
Extensive human rights education, research, training and knowledge dissemination should be carried out to create a cultural atmosphere in which the whole society respects and protects human rights (policy 1)	The whole society respects and protects human rights	Human rights
Comprehensive Development of Women (Policy 2)	Comprehensive development of women	Development
Coordinate the balanced development of women among urban and rural areas, regions, and various social groups, and promote the comprehensive development of women in all fields (Policy 2)	Balanced development of women among urban and rural areas	Equality Development
Implement the people-centred development philosophy (policy 2)	People-centered development	Development
Fully leverage the unique role of women in both social and family life, significantly enhancing women's sense of achievement, happiness, and security (policy 2)	Enhancing women's sense of achievement, happiness, and security	Development
Taking into consideration of the practical differences between genders and the specific interests of women when deploying the work (policy 2)	Considering gender practical differences and the specific interests of women	Equality
Promote gender equality and women's comprehensive development (policy 2)	Gender equality and women's comprehensive development	Equality Development
Building a world where women are free from discrimination (policy 2)	Women are free from discrimination	Equality
To build a society of inclusive development (policy 2)	Society of inclusive development	Development
Stimulate the innovation vitality of female scientific and technological talents (Policy 3)	Stimulate female innovation vitality	Development

Empower female scientific talents to build a world scientific and technological power (Policy 3).	Build a world scientific and technological power country	Development
Empowering Exceptional Women in Science and technology for Global Impact, catalysing contributions to establishing worldwide scientific and technological leadership (Policy 3).	Empowering exceptional STEM women	Development
Contribute female power to China's strategic shift from being a major technological power to a leading technological nation, play a role in promoting technological self-reliance, and contribute to the initiation of a new journey in the comprehensive construction of a socialist modernized country (policy 4)	Contribute female power to build a leading technological nation	Development
Prioritize the development of education, vigorously advance the modernization of educational concepts, systems, structures, content, methodologies, and governance (policy 5)	Prioritize the development of education	Development
Improve the quality of education, promote equity in education, and optimize the structure of education (policy 5)	Improve quality and equity of education	Quality education Equality Development
Establish a modern education system that serves lifelong learning for all, promotes quality preschool education, achieves high-quality and balanced compulsory education, ensures comprehensive access to secondary education, significantly enhances vocational education service capabilities, markedly improves competitiveness in higher education, provides suitable education for children with disabilities, and creates a new governance framework for education involving the active participation of the entire society(policy 5)	Promote quality education development	Quality education Development

The first theme refers to equality for women in STEM is benefit for and aims at development. There are several characters for development according to the sub-themes，free and comprehensive development for all, comprehensive development of women, balanced development of women among urban and rural areas, people-centered development, gender equality and women's comprehensive development, society of inclusive development, stimulate female innovation vitality, build a world scientific and technological power country, empowering exceptional STEM women, improve quality and equity of education, enhancing women's sense of achievement, happiness, and security.

Based on the content of sub-themes, it can be concluded that the main goals of gender equality

in STEM fields are to achieve gender equality, stimulate the vitality of women and build a power country in science and technology, which is related to the fact that China is a developing country and focuses on developing its economy and strength. The subject of its development process is categorized into women scientists, women, all people. Its development is characterized by free, comprehensive, balanced among urban and country, people-centered, inclusive development. The final aim is to build a world scientific and technological power country. The development of education focuses on promoting the equity and quality of education.

Policy 1 refers to 'Free and comprehensive for all" as the overall goal of the development, with "freedom" meaning no obstacles, "comprehensive" referring to all fields in human rights, including the basic right to work, social security rights, property rights, health rights, education rights, cultural rights, life rights, personal rights, interests in personal information, freedom of religious belief, the right to vote and stand for election, the right to know and participate, the right to expression and supervision, the right to a fair trial, environmental rights and other rights, being comprehensively protected' (Policy 1). Considering the objectives of Policy 1, namely 'Strengthening the equal protection and special assistance of the rights and interests of specific groups and promoting the equal sharing of the fruits of development by all people', as well as the protection of ethnic minorities, women, children, the elderly and the disabled, listed as part of the protection of the rights and interests of specific groups, it can be concluded that the subject of common development includes 'all groups'. The policy stating to 'adhere to a people-centered development ideal and emphasize people's happiness as the greatest human right' is a 'human-central' statement, indicating that the policy's vision is aimed at the basic rights and needs of people so as to promote their common prosperity and happiness.

Policy 2 refers to "gender equality and women's comprehensive development" and "society of inclusive development" in the development vision. The comprehensive development promoted by the policy 2 includes all fields and all groups of women. As mentioned in the preface of the policy, 'There are gaps in women's development between urban and rural areas, regions and groups, and efforts to ensure the livelihood of women in rural areas, especially in less developed

areas, need to be intensified ... Women still face practical difficulties in ensuring their equal rights in employment, personal property, marriage and family ... The level of women's participation in the management of state and economic, cultural and social affairs needs to be comprehensively improved'. The "society of inclusive development" is coherent with building a world that women can be free from discrimination, establishing a connection to the meaning of inclusion and avoiding discrimination.

Policy 3 and Policy 4 refer to "stimulate female innovation vitality", "build a world scientific and technological power country", "empowering exceptional STEM women", "contribute female power to build a leading technological nation" as the development goal. Policy 3 and Policy 4 mention that 'Female scientific and technological talents are an important part of the scientific and technological talent team' and 'We must adhere to gender equality and equal opportunities, create a better environment for female scientific and technological talents to grow and progress, display their talents, and play their roles, and strive to create top female scientific and technological talents with world influence, giving full play to the roles of female scientific and technological talents in promoting innovation-driven development, achieving high-level scientific and technological self-reliance and building a global scientific and technological power'. According to these policy discourses, Policy 3 and Policy 4 are concerned with the overall development of China as their main vision. They also hope to promote the development of women in STEM through a gender-equal environment, especially the development of top females with STEM talents to promote the development of STEM and the vision of a STEM-powered country.

Policy 5 is a guiding document for promoting the modernisation of education in China. With regard to higher education, the document states the vision theme of "improve quality and equity of education". The policy lays out a vision for the development of higher education to 'promote the quality, equity and competitiveness of higher education', but it does not mention anything related to women's participation in higher education or gender equality.

Table 15. Sub-themes of Development Theme in the Vision of Chinese Policies

MAIN THEME	SUB-THEMES
Development	Free and comprehensive development for all
	Comprehensive Development of Women
	Balanced development of women among urban and rural areas
	People-centred development
	Gender equality and women's comprehensive development
	Society of inclusive development
	Stimulate female innovation vitality
	Build a world scientific and technological power country
	Empowering exceptional STEM women
	Improve quality and equity of education

The second theme refers to the vision to promote equality. From the policy statement, it can be found that equality including the whole course from the process to result. There are 6 sub-themes recognized under the theme equality, equal protection for all and special assistance of specific groups, balanced development of women among urban and rural areas, considering gender practical differences and the specific interests of women, gender equality and women's comprehensive development, women are free from discrimination, improve quality and equity of education. It can be concluded that, the way to promote equality is to make sure that the actions are taken under the principle of equality, equal protection for all and special assistant of specific group, for example. For "special assistant of specific group", it should be considering gender practical differences and the specific interests of women. For "equal protection", it needs to make sure that "women are free from discrimination", "women among urban and rural areas" should be balanced development. Moreover, specific attention is on the equity in education. The third sub-theme refers to the vision to promote quality education which emphasis equality and quality at the same level. However, from the national education development document, gender is not viewed as a variable, the gender equality in and through education is not an agenda for education policy.

Table 16. Sub-themes of Equality and Quality Education Theme in the Vision of Chinese Policies

MAIN THEME	SUB-THEMES
Equality	Equal protection for all and special assistance of specific groups
	Balanced development of women among urban and rural areas
	Considering gender practical differences and the specific interests of women
	Gender equality and women's comprehensive development
	Women are free from discrimination
	Improve quality and equity of education
Quality education	Improve quality and equity of education
	Promote quality education development

All the policies may reveal that inclusion is rarely used directly in visions as policy discourse. Direct statements related to inclusion appear in Policy 2 with regard to 'building a world where women are free from discrimination and creating a society with inclusive development' and 'creating an equal, inclusive and sustainable development environment'. In addition, China's policy discourse on gender equality is focused on gender equality and human rights. The purpose of promoting inclusiveness can be inferred from the content of policies, such as a more optimised development environment (Policy 2) and freedom (Policy 1), which describe an egalitarian environment conducive to the development of full potential. In policies in which education is the focus, such as the education rights sections of Policy 1 and Policy 5, the policy discourse focuses on educational equity, but does not specifically treat women as a special variable, nor does it promote the realisation of women's education rights in education policies nor statements related to equity issues for women in education. In general, the educational vision primarily emphasizes equality and quality, with inclusion not being explicitly incorporated as a defining characteristic of education. Moreover, gender-inclusive visions are not articulated as direct policy discourse for education and in general.

With regard to Italian policies, Italian polices also doesn't have the topic directly named as policies for promoting gender equality in STEM in HE. The policies selected are the policies on promoting gender equality. Policies in Italy include:

● The National Strategy for Gender Equality 2021-2026 (Policy 6)

- National Recovery and Resilience Plan in Italy (PNRR) (Policy 7)

- Woman for a New Renaissance (2020) (Policy 8)

- Guidelines for Guidance 2022 (Policy 9)

- Guidelines for the Gender Budget in Italian Universities (Policy 10)

- National Guidelines (art. 1 paragraph 16 l. 107/2015) Education Respecting Gender Equality, the Prevention of Gender Violence and All Forms of Discrimination (Policy 11)

- Affirmative Action Directions for Gender Issues in Universities and Research (Policy Proposal 12)

- Analysis and Proposals on Gender Issues in Italian Universities (Policy Proposal 13).

Table 17. Themes of Vision of Gender Equality Policies in STEM HE in Italy

POLICY TEXT	SUB-THEME	THEME
Make Italy a country where people of all kinds, ages and backgrounds have the same opportunities for development and growth, personal and professional, for access to the world of education and work, without inequality of economic treatment or dignity. (Policy 6)	Same opportunities and treatment for development	Equality Development
Can realize your potential with the awareness of guaranteed and uncompromising equality in a modern country prepared to face the challenge of the times. (Policy 6)	Awareness of guaranteed and uncompromising equality	Equality
	Realize your potential	Development
For the first time, Italy has committed itself to defining the National Strategy to promote equal opportunities and gender equality (Policy 6).	Promote equal opportunities and gender equality	Equality
Seeking and pursuing equal opportunities means looking at the constitutional principles of equality to make them history in the stories of today's women and men. It means choosing to eradicate the unjust concepts and behaviours that still prevent female citizens from living, being and acting as equals with all other citizens (Policy 6).	Eradicate the unjust concepts and behaviours that still prevent female citizens from living	Equality
Gender equality is an extraordinary driver of growth and one of the most relevant and urgent cornerstones of the development and progress agenda of countries (Policy 6).	Gender equality is a driver of growth	Development
Mission 5 "cohesion and inclusion ": the promotion of female empowerment and the fight against gender discrimination are objectives that intersect almost all PNRR missions (Policy 7).	Promote female empowerment and fight against gender discrimination	Equality

Instrument that uses Next Generation Europe funds to make Italy more equitable, sustainable and inclusive. The plan aims to help build a new Italy, leaving behind the economic and social impact of Covid-19 (Policy 7).	Build a new Italy, leaving behind the economic and social impact of Covid-19	Development
Science: engine of a New Renaissance (Policy 8)	Science is engine of a New Renaissance	Development
There are proposals to increase the percentage of women in all areas of work, to overcome the barriers to advancement in career paths, especially in the fastest growing fields (STEM, IT, cloud computing, data and artificial intelligence), to counter gender stereotypes that prevent women from achieving leadership responsibilities (Policy 8).	Counter gender stereotypes to achieve leadership responsibilities	Equality
	Overcome the barriers to advancement in STEM and other fastest growing fields	Equality Development
For active guidance in the transition from school to university, PNRR aims to guide transformation by strengthening the connection between the first cycle of education and the second cycle of education and training (the first cycle of education is compulsory and consists of primary and lower secondary education. Primary education (istruzione primaria) starts at 6 years of age and lasts for five years. Lower secondary education (istruzione secondaria di I grado) starts at 11 years of age and lasts for three years. Conscious and mindful choices enhance the potential and talents of students while contributing to the reduction of school dropouts and promoting access to training opportunities in tertiary education) (Policy 9).	Strengthening the connection between the first cycle and the second cycle of education and training	Development
Guidance is a process aimed at facilitating self-knowledge, of the educational, occupational, social, cultural and economic context of reference, of the strategies implemented for relate and interact in these realities, in order to promote maturation and development of the skills necessary to be able to autonomously define or redefine personal and professional objectives adhering to the context, elaborate or re-elaborate a life project and support the relative choices"(Policy 9).	Facilitate knowledge to redefine personal and professional objectives	Development
A structured and coordinated system of interventions is needed which, starting from the recognition of students' talents, aptitudes, inclinations and merit, accompanies them in an increasingly personalized way to critically and proactively elaborate their life project, even professional (Policy 9).	Recognition of students' talents and elaborate their life project	Development
'Effective operational tool to facilitate the drafting of the document through the presentation of the requisites required by the European Commission and illustrate how it should be included in the Strategic Plans of Italian Universities in synergy with other actions aimed at achieving organisational well-being and gender equality (Policy 10).	Achieving organisational well-being and gender equality	Equality

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As part of the skills that pupils must acquire, education in the fight against all types of discrimination plays a fundamental aspect, and promotion at every level of respect for the person and for differences without any discrimination. (Policy 11)	Educate for fighting against discrimination and respecting difference	Equality
The school must commit to achieving real inclusion to enhance individuality and educate the new generations on the positive value of differences and the culture of respect. (Policy 11)	Achieve real inclusion, educate the value of differences, and respect	Inclusion Equality
Starting from the international, European, and national framework outlined above, the present document aims to indicate some reflections and proposals for the development of adequate gender policies in Italy, in the field of research and university education. (Policy proposal 12)	Reflections and proposals for gender policies in Italy in research and university education.	Equality
This report shows the results of a comparative analysis of statistical data relating to the presence of women in the Italian university system and aims to highlight improvements and involutions in the pursuit of gender equality which have occurred in recent years. (Policy proposal 13)	Highlight improvements and involutions in the pursuit of gender equality	Equality

There are 3 themes being recognized as the vision, equality, development, and inclusion in Italian policies. With regards to the theme equality, sub-themes same opportunities and treatment for development, awareness of guaranteed and uncompromising equality, promote equal opportunities and gender equality, eradicate the unjust concepts and behaviours that still prevent female citizens from living, promote female empowerment and fight against gender discrimination, counter gender stereotypes to achieve leadership responsibilities, overcome the barriers to advancement in STEM and other fastest growing fields, achieving organisational well-being and gender equality, educate for fighting against discrimination and respecting difference, achieve real inclusion, educate the value of differences, and respect, reflections and proposals for gender policies in Italy in research and university education, highlight improvements and involutions in the pursuit of gender equality are recognized. With regards to the value of equality in Italian policies, gender equality in universities education and research is highlighted especially the STEM fields are viewed as the engine for equality and development. The way to promote gender equality including promoting equal opportunities and eliminating

gender discrimination and the framework of values including same opportunities and treatment, guaranteed and uncompromising equality, equal opportunities. The sub-theme of Same opportunities and treatment for development including realize your potential, gender equality is a driver of growth, build a new Italy, leaving behind the economic and social impact of Covid-19, science is engine of a New Renaissance, overcome the barriers to advancement in STEM and other fastest growing fields, strengthening the connection between the first cycle and the second cycle of education and training, facilitate knowledge to redefine personal and professional objectives, recognition of students' talents and elaborate their life project. Within the development theme, STEM fields are seen as engines of development, and overcoming barriers to progress in STEM and other fastest growing fields is seen as an important means to promote gender equality. In addition, the development goal is to promote more students to study in university through directed education in schools, and more students choose to study STEM. The theme inclusion being described as "achieve real inclusion, educate the value of differences, and respect". The gender equality education policy aimed at promoting gender equality through education that make sure that the student understanding the value of difference, respect difference so as to promote the development of potential.

Policy 6 describes a vision to 'Make Italy a country where people of all kinds, ages and backgrounds have the same opportunities for development and growth, personal and professional, for access to the world of education and work, without inequality of economic treatment or dignity'. In terms of the overall approach of the state, the subjects include people of all kinds, ages and backgrounds. The equality content involves equal opportunities in terms of economic treatment and dignity, as well as development and growth, which means everyone has an equal right to develop their potential. Policy 6 describes how gender equality 'can realise one's potential with the awareness of guaranteed and uncompromising equality in a modern country prepared to face the challenges of the times', presenting itself as a national 'awareness of guaranteed and uncompromising equality'.

As it describes, the National Recovery and Resilience Plan is the instrument that uses Next Generation Europe funds to make Italy more equitable, sustainable and inclusive. The plan aims

to help build a new Italy, leaving behind the economic and social impact of Covid-19. The Women for a New Renaissance (Policy 8) aims for the development of women after the Covid-19 pandemic. With Covid-19 as its background, it describes in its introduction how the key words for this era are connection, promotion, care and education. With regard to connection, it states this is 'because we are called to contrast with the dehumanising abstraction, the concreteness of reassembling, of creating bonds and correlations capable of activating historical, economic and social dynamism, thereby connecting places, experiences, skills and areas of life'. This shows that in this difficult period of global dehumanising difficulty, it is necessary to have cohesion to connect different places, experiences, skills and areas of life together. Policy 8 also states, 'Promote, not just protect', with the word promote focusing on how the action should not just be protection, which is not active enough. Active action should be taken to recognise the value of everyone. In this difficult time, it is necessary to care for others in society with understanding, which creates a sense of belonging. Education may be viewed as a tool for transforming, with education forming a new language of truth that goes beyond stereotypes.

The guideline (Policy 9) is an 'effective operational tool to facilitate the drafting of the document through the presentation of the requisites required by the European Commission and illustrate how it should be included in the Strategic Plans of Italian Universities in synergy with other actions aimed at achieving organisational well-being and gender equality'. This means it is a tool for gender equality and well-being.

Policy 10 is the policy for student guidance and has a vision of development. There are many definitions of orientation, one of which is the one shared between the government, regions and local authorities in 2012, whereby 'orientation is a process aimed at facilitating knowledge of the self, of the educational, occupational, social, cultural and economic context of reference, of the strategies implemented to relate and interact in these realities to promote the maturation and development of the skills necessary to be able to autonomously define or redefine personal and professional objectives adhering to the context, elaborate or re-elaborate a life project and support any relevant choices'. Therefore, through guidance to determine their self-knowledge and social knowledge, allowing them to make sound choices in their lives for their professional

objectives. With investment 1.6 of PNRR (Policy 7), for active guidance in the transition from school to university, PNRR aims to guide transformation by strengthening the connection between the first cycle of education and the second cycle of education and training. The first cycle of education is compulsory and consists of primary and lower secondary education. Primary education (*istruzione primaria*) starts at 6 years of age and lasts for five years. Lower secondary education (*istruzione secondaria di I grado*) starts at 11 years of age and lasts for three years. Conscious and mindful choices enhance the potential and talents of students while contributing to the reduction of school dropouts and promoting access to training opportunities in tertiary education. Moreover, in the guidance for higher education, the guidance for further understanding how to make sound life choices depending on one's potential and social knowledge is crucial. As stated in Policy 10, 'the analyses and perspectives of this framework are still valid references today for the design and implementation of an effective lifelong guidance system'. This means the part of higher education should also be included for lifelong guidance.

Part IV of Policy 11 states that 'the school must commit to achieving real inclusion to enhance individuality and educate the new generations on the positive value of differences and the culture of respect'. With this statement, the vision of this policy appears to be an inclusive society through the use of education to promote respect, with the content of education being on the value of difference. As stated in the conclusion of the guidelines, it does not, 'therefore, promote thoughts or actions inspired by ideologies of any nature, but rather transmits knowledge and awareness regarding rights and the constitutionally guaranteed duties of the person'. Policy 11 also holds a vision of learning human rights as the basis of understanding.

Policy propolsal 12 aims to indicate some reflections and proposals for the development of adequate gender policies in Italy, in the field of research and university education.

Policy proposal 13 shows the results of a comparative analysis of statistical data relating to the presence of women in the Italian university system and aims to highlight improvements and involutions in the pursuit of gender equality which have occurred in recent years.

Table 18. Themes and Sub-themes of Vision of Gender Equality Policies in STEM HE in Italy

THEME	SUB-THEME
Equality	Same opportunities and treatment for development
	Awareness of guaranteed and uncompromising equality
	Promote equal opportunities and gender equality
	Eradicate the unjust concepts and behaviours that still prevent female citizens from living
	Promote female empowerment and fight against gender discrimination
	Counter gender stereotypes to achieve leadership responsibilities
	Overcome the barriers to advancement in STEM and other fastest growing fields
	Achieving organisational well-being and gender equality
	Educate for fighting against discrimination and respecting difference
	Achieve real inclusion, educate the value of differences, and respect
	Reflections and proposals for gender policies in Italy in research and university education.
	Highlight improvements and involutions in the pursuit of gender equality
Development	Same opportunities and treatment for development
	Realize your potential
	Gender equality is a driver of growth
	Build a new Italy, leaving behind the economic and social impact of Covid-19
	Science is engine of a New Renaissance
	Overcome the barriers to advancement in STEM and other fastest growing fields
	Strengthening the connection between the first cycle and the second cycle of education and training
	Facilitate knowledge to redefine personal and professional objectives
	Recognition of students' talents and elaborate their life project
Inclusion	Achieve real inclusion, educate the value of differences, and respect

3.3.2 Implementation: Does Policy Support the Implementation of Female Learners' Right to Gender Inclusivity and Equitable Educational Opportunities?

In Chinese policy and Italian policy, there are ten themes and 38 sub-themes that can be recognised. There are eight themes that are similar for both, while for Italian policy, gender funding and structural gender equality are also policy priorities.

In terms of Chinese policies, Policy 2 mentions cultivating women's interest in STEM by highlighting 'cultivating the interest and ambition of girls in compulsory education to love science and learn science' and 'guiding girls in high school to develop a scientific interest and research spirit, and supporting girls who are eager to apply for polytechnic colleges and

universities'. Cultivating female STEM interest is revealed through the sub-themes of female scientist role models, increasing participation in STEM activities, increasing participation in STEM competitions and improving women's STEM literacy. The female scientist role model sub-theme can be achieved by 'carrying out activities with female scientists visiting campuses and giving full play to the leading role of outstanding female scientific and technological talents' (Policy 1) and 'vigorously publicising the deeds of female scientists and the outstanding contributions of women in science and technology' (Policy 4), with female scientist role models playing a leading role. Under the STEM activities and STEM competitions sub-themes, 'guid[ing] primary and secondary school girls to participate in various science popularisation activities and science and technology competitions' is suggested in Policy 2 and Policy 3. Under the STEM literacy sub-theme, it is stated in Policy 2 that it is necessary to strengthen the education, dissemination and popularisation of scientific literacy among women by carrying out scientific equality actions for all people and by using modern scientific and technological information means. However, it is worth noting that although Policy 2 states that national scientific literacy actions and modern scientific and technological information methods are necessary for strengthening the education, dissemination and popularisation of scientific literacy among women. However, according to the latest Chinese State Council notice on the issuance of the National Scientific Literacy Action Plan (2021-2035), the proportion of citizens with scientific literacy reached 25%, and the gap in the development of scientific literacy between urban and rural areas and regions has been significantly narrowed. The main goal of laying a solid social foundation at the forefront in China is to promote science education and science popularisation at the higher education stage, including promoting the construction of basic science courses and supporting university students' innovation and entrepreneurship. However, the gender perspective is not included in this.

The sub-themes of international academic exchanges, subject base, frontier science centre, cultivating top female talent and multi-level are included in the academic support theme. Concerning the sub-theme of international academic exchanges, Policy 3 suggests encouraging 'more female university students to participate in international academic exchanges' (Policy 3).

The sub-themes of subject base and frontier science centre are discussed in Policy 2, which mentions 'supporting the construction of bases for basic disciplines such as mathematics, physics, chemistry and biology and cutting-edge science centres, and strengthening the training of top female talents in basic disciplines'. The sub-theme of cultivating top female talent is also discussed here in Policy 2. Considering all these different ways of supporting female students, this can be characterised as multi-levelled, which is also suggested in the statements to 'explore the establishment of a multi-level system for training female science and technology talents and cultivating internationally competitive female science and technology talents' (Policy 2) and 'encourage female university students to actively participate in project design, social practice, innovation and entrepreneurship, science and technology competitions and other activities' (Policy 2).

The theme of female student guidance includes the sub-themes of professional guidance, eliminating gender stereotypes and female academicians' guidance. The sub-theme professional guidance refers to the type of guidance, which can include 'targeted subject selection and career planning guidance' (Policy 2), 'guidance on career development planning' (Policy 3) and 'guidance on pursuing a research career' (Policy 4). With regard to the theme of eliminating gender stereotypes, in terms of high school students, it aims to 'improve women's ability to make independent choices and eliminate the influence of gender factors on women's academic and career development' and 'eliminate effects of gender stereotypes' (Policy 2) to guide female students' STEM career choices and work. In addition, Policy 3 also stipulates that 'female academicians and professors should focus on cultivating discovered talents and provide guidance for young women in science and technology to grow into talents'.

As education can be viewed as an important tool for promoting gender equality, gender equality education can help people recognise the gender stereotypes and biases embedded in society. As education itself is gendered, education can be transformed and gender can be employed as an important perspective that has the potential to change gender social structures.   Several sub-themes may be recognised under the theme of gender and education, with gender equality courses, teacher training, textbooks, teaching processes and gender mainstreaming being noted.

Under the theme of gender equality courses, as is stated in Policy 2, there is an aim to 'strengthen the construction of women's colleges and universities, encourage qualified colleges and universities to offer courses related to women's studies and gender equality' and 'cultivate professionals with an interdisciplinary knowledge base and gender equality awareness'. Moreover, gender equality education should be conducted with the aim to 'promote the development of gender equality curricula tailored to local conditions' and 'promote gender equality education in schools at all levels' (Policy 2). To reduce gender harassment, it is also necessary to 'encourage schools to set up life education, mental health education and prevention of sexual assault and sexual harassment-related courses', which would improve students' self-protection awareness and abilities.

With regard to the sub-theme of teacher training, the teacher training work should be conducted by 'strengthening the training of specialised teachers on gender equality … including a gender component in the curriculum and teaching of teacher training institutions (K12 teacher education universities)' (Policy 1) and 'in the training of teachers in schools' (Policy 1). The theme of gender mainstreaming not only refers to gender equality courses and teacher training as gender should also be embedded in all kinds of activities, education stages and all perspectives of education. Policy 1 describes 'timely issuing guidelines on gender equality education', 'promoting gender equality education into school teaching content, campus culture, club activities and social practice activities' and 'integrating the basic national policy of gender equality into compilations of textbooks, curricula and the teaching process'. Besides, 'strengthening the construction of teachers' ethics' (Policy 2) should also be used to prevent gender violence and harassment. The theme of gender and education can be identified in Policy 1 as well as its sub-theme of female education rights. This is because the policy emphasises the guarantee of women's equal rights to education, while specifically mentioning the improvement of women's scientific literacy. The goal of cultivating female scientific and technological talents shows that promoting women's studies of science is an important aspect of realising women's equal right to education.

For the theme of access to justice, the sub-themes of enrolment supervision, unequal

punishment and STEM incentive measures have been recognised. In China, depending on the characteristics of the major, some majors legally have gender standards in admissions. However, some standards are too strict and lead to gender inequality in admissions. This policy is constructed to establish restrictions. The measure is concerned with promoting equal access for women through equal access to admission. As some majors may use specific gender standards, it is necessary to control the sphere of the specific major in terms of gender and strengthen supervision, while establishing interview and punishment mechanisms. Therefore, the sub-themes of enrolment supervision and unequal punishment are recognised. The sub-theme suggests 'using incentives to increase the percentage of women in science, technology, engineering and maths subjects' (Policy 2).

With regard to the financial support theme, the scholarship sub-theme can be recognised. Policy 3 states that the policy supports institutions of higher learning and research institutes in setting up scholarships for outstanding female students majoring in STEM subjects. Gender in research is addressed through the STEM and gender and gender in STEM research programmes sub-themes. As stipulated in Policy 1, research on STEM and gender is suggested. It advises 'continuing to carry out science, technology and gender research', 'evaluating science and technology policies on gender equality' and 'conducting follow-up research on the growth of female science and technology talents' (Policy 2). Concerning gender and STEM research programmes, increasing the proportion of women's or gender studies-related topics in major research projects such as National Social Science Fund projects (Policy 2).

In terms of the policies in Italy, under the theme of cultivating female STEM interest, STEM activities, multi-body and propagation are recognised as the sub-themes. Under the sub-theme of STEM activities, different kinds of activities have been suggested like STEM activities, internships, experimental activities and creating a STEM summer camp (Policy 6, Policy 8). Under the multi-body sub-theme, there is an aim 'to establish a single platform for offers of STEM activities and internships for women and girls, encouraging offers of experimental activities, in cooperation with different stakeholders (companies, research centres, schools, etc.). Starting in the summer of 2020, summer camps with a preponderant component of STEM

subjects are promoted and created as well, introducing a hands-on, learning from failure approach' (Policy 8). Under the propagation sub-theme, Policy 8 mentions 'promoting the importance of STEM training for girls' future careers and the central role of knowledge/skills in these sectors, building the future (environmental issues, energy, sustainable development and health) to raise girls' awareness of STEM subjects'. By analysing these policies, it is evident that the way of cultivating female student STEM interest normally occurs before higher education.

Under the academic support theme, the sub-theme of upgrading courses is recognised. Upgrading courses are provided to students before higher education who need to improve their study results. The aim is to improve their STEM knowledge and lay a solid foundation for their future studies. This is recommended in Policy 6, which writes about 'introducing upgrading courses in STEM disciplines ... the allocation of funds for voluntary upgrading courses in scientific and mathematical disciplines (e.g. mathematics, physics, chemistry, geometry) as well as in financial education; these courses will be held at school, in classrooms and laboratories in extracurricular hours and will be intended for all students enrolled in high schools scoring below the average in the INVALSI-PISA tests. In proportion to the total number of students, places are to be made available in classes with fewer students to enable teachers to pay greater attention to the needs of each participant. Any further gender interpretation or classification will be evaluated' (Policy 6). It also writes about 'strengthening teaching in mathematical disciplines through extracurricular hours of compulsory maths, especially in those middle and high schools showing particularly severe weaknesses in these disciplines' (Policy 6). However, academic support is only suggested for students before tertiary education and academic support does not refer to females in higher education.

Under the theme of female guidance are the sub-themes of eliminating gender stereotypes, shadowing programmes and STEM choice. The eliminating gender stereotypes theme is suggested in Policy 6, arguing that it should be promoted through 'psychological support programmes in middle and high schools, aimed at providing aptitude guidance and overcoming gender stereotypes and focusing on how girls consider STEM disciplines as well as the

influence of cultural and family background on academic and career choices'. Shadowing programmes are then conducted on the basis of giving positive guidance through phycological influence. A shadowing programme in this context can described as 'having female university students speak in schools or offer one-to-one interviews' and 'encouraging business representatives to speak in schools or online for outreach purposes'. Concerning the STEM choice theme, one suggestion is related to Investment 1.6 of PNRR (Policy 7) and promoting students at university by 'strengthening ministerial and school activities to guide high school students through university and employment, especially directed at encouraging career development for women in the STEM and technological fields; this includes mandating a tour during open university days for fourth and fifth-grade students'. Although Policy 10 is related to guidance for students and is constructed to conduct the PNRR, the promotion of women in STEM is not included, which leads to a contradiction with Policy 6 and Policy 7. Furthermore, Policy 6 suggests 'promotion and guidance for vocational qualifications in traditionally male-dominated jobs and vice versa, with the aim of encouraging female entrepreneurship in the agricultural sector'.

Under the theme of widening access, the sub-theme of gender reserve is recognised. Policy 8 states a plan to reserve a certain amount for female students in STEM disciplines, especially in universities with a very low female presence. The standard for reserving female students is according to their entry tests in which the subject needs to reach a minimum score.

Under the theme of financial support is the sub-theme of scholarships. The types of scholarships can include the 'granting of public scholarships for female STEM students (in addition to any private or public-private scholarships)' (Policy 6) and 'establishing postgraduate and postdoctoral scholarships in STEM fields specifically aimed at women, to be awarded on the basis of the value of the research project' (Policy 8).

Under the theme of gender and research, gender dimension, gender data, gender in content and gender in selecting projects are mentioned in Policy 9, promoting the 'integration of the gender dimension in research' (Policy 9). In Policy Proposal 12, it is suggested to involve gender in research through collecting data on gender in research samples. With regard to the gender in

content sub-theme, it is suggested to involve gender perspectives in the research content, including gender influences in research results (Policy Proposal 12). Under the sub-theme of gender in selecting projects, it is recommended that almost 40% not less than 30% of every gender in the construction of the panel used for a research project.

The term gender is described in various ways in education, such as the 'promotion of the principle of gender equality' (Policy 6), the 'introduction of gender mainstreaming notions' (Policy 6) and the 'integration of the gender dimension' (Policy 9). Policy 11 is a policy specifically issued for the implementation of gender equality education. In Italy, the implementation of gender equality education is carried out based on laws on gender equality in education. Its legal provisions according to Italian law, specifically Paragraph 16 of Article 1 of L.107 of 2015, state: 'The three-year plan of the training offer should ensure the implementation of the principles of equal opportunities by promoting in schools and all levels and degrees of education gender equality, the prevention of gender violence and all discrimination'. The paragraph implements the principle fundamentals of equal dignity and non-discrimination, referred to in Article 3 of the Italian constitution: 'All citizens have equal social dignity and are equal before the law, without distinction of sex, race, language, religion, political opinions, personal and social conditions. The task of the Republic is to remove economic and social obstacles, which, by limiting the freedom and equality of citizens, prevent the full development of the human person and the effective participation of all workers in the political, economic and social organisation of the village.' Building on this law, Policy 11 proposes that respectful education may promote gender equality and prevent gender violence and all forms of discrimination. The dimensions of education include all levels of education, especially the education process (Policy 6), teacher training (Policy 6, Policy 8), the curriculum (Policy 6) and academic assessment (Policy 6). Thus, the theme of gender and education contains the sub-themes gender equality courses, teacher training, teaching process, gender-neutral grammar, pedagogical innovation and interdisciplinary approaches.

Concerning the theme of gender equality courses, classes on gender mainstreaming are suggested to be conducted by qualified staff in Policy 6, stating that 'lectures or classes on

gender mainstreaming should be held during school hours by qualified staff, including the assessment of the minimum number of hours/interactions with the students' (Policy 6).

With regard to the textbook sub-theme, policy suggests that textbooks should be transformed to eliminate gender stereotypes, with Policy 6 and Policy 11 suggesting the transformation of textbooks including 'the reform of the requirements for textbooks and training materials to encourage publishers to give visibility to women', 'verifying the adequacy of the language used in textbooks of all disciplines ... with regard to the presence of any stereotypes of the masculine and feminine', 'verifying the adequacy of the language used in textbooks of all disciplines' and 'the reform of the requirements for publishing and/or recommending the purchase of school books for primary and secondary schools'. The direction to promote transformation should be 'focusing on examples of women who have made a fundamental contribution to building up knowledge and understanding of the subject, which is to ensure that they do not promote gender stereotypes, but on the contrary, encourage parity and equality'. Furthermore, the 'preparation of educational materials should not only emphasise gender sensitivity but also include education on violence against women'. Although gender sensitivity education itself plays a preventive role in reducing awareness of violence against women, education on combating violence against women is also necessary. Thus, ways to eliminate gender stereotypes as well as language and content to prevent gender violence should be included in the textbooks.

The teacher training should be enhanced by teacher training to improve knowledge about gender mainstreaming, gender stereotypes and digital pedagogy.

Teacher training is also an important part of education, with training on updating numbers and raising awareness of gender stereotypes (Policy 8), and teachers from primary school and beyond taking part in mandatary training. Introducing the concept of gender mainstreaming in training and teacher training in education is also an important component of this mandatory training for teachers with regard to gender mainstreaming and gender stereotyping, especially in STEM and highly segregated subjects (Policy 6).

The teaching process theme relates to how to involve gender perspectives in the teaching process. Policy 11 suggests that 'the work of teachers must be oriented towards a sensitive

approach to differences (for example by enhancing the presence of women in major historical and social processes and their contribution to the progress of sciences and arts)' and 'it is suggested to verify the adequacy of the language used in textbooks of all disciplines'.

Under the sub-theme of gender-neutral grammar, Policy 11 mentions that non-sexist language should be used in textbooks and school life.

Concerning the pedagogical innovation sub-theme, this can be implemented through innovative mathematical pedagogy, the growing relationship between neuroscience and education, digital education, digital learning, cooperation between parents and teachers and renewing the type of mathematics pedagogy (Policy 8).

Ways to promote STEM choices among females at the university level include interdisciplinary approaches such as introducing compulsory humanities courses in STEM subjects and compulsory science courses in humanities courses (Policy 8).

Under the theme of structural gender equality, the sub-themes of gender equality evaluation, gender quotas and gender equality language are noted. With regard to the gender equality evaluation sub-theme, Policy 6 suggests an idea about how to encourage gender equality in the evaluation process. The idea is related to the introduction of gender quotas in university staff evaluation boards and gender-neutral evaluations of academic performance. Thus, there are two processes, namely the 'introduction of gender quotas in the boards responsible for the selection, appointment and evaluation of all professors (full and associate professors) and in all joint decision-making bodies (e.g. the Academic Senate)' and the 'definition and application, during the above-mentioned evaluations, of objective gender-neutral criteria for the evaluation of academic performance' (Policy 6). Moreover, Policy 12 suggests forming a gender evaluation expert base to evaluate gender issues in the higher education system. With regard to the gender quota sub-theme, it suggests having a certain proportion of female researchers in higher education institutions, referring to the 'presence of appropriately scored male and female researchers' (Policy 12). Furthermore, there have been suggestions to ensure equal representation in decision-making bodies such as liaison structures, department councils, academic senates and boards of directors as well as reward measures for the universities that

implement this (Policy Proposal 13). With regard to the sub-theme of gender equality language, the use of respectful language has been suggested for adoption in all media of all university bodies before creating, within each university, a monitoring and awareness group on this issue, with, for example, the power to request the revision of papers (Policy Proposal 13).

With regard to the gender in funding theme, the sub-themes include gender quotas, unequal sanctions and equal rewards. This includes the reform of the mechanism for the allocation of MUR funds and the establishment of a gender quota to allocate dedicated MUR funds to universities that achieve minimum gender representations, focusing on groups such as 'education personnel, researchers, administration, academic regents, and the number of female students in STEM subjects' (Policy 6). It is advised to adopt objective, gender-neutral criteria for the evaluation of academic performances in boards responsible for the selection of all professors while decertifying institutions and sanctioning universities in accordance with gender equality evaluations using the funds set aside by the MIUR for daily activities (Policy 6). Under the equal reward theme, there is a suggestion to reward higher education institutions that achieve the gender quota in the personnel management process. This is suggested to 'ensure equal representation in decision-making places (e.g., Liaison Structures, Department Councils, Academic Senates, Boards of Directors) along with rewarding measures for the universities that implement it; to introduce, among the indicators related to the awarding of university awards, parameters that promote gender equality, in particular as regards the recruitment and careers of personnel' (Policy Proposal 13).

Table 19. Comparing the Implementation of Policies from Italy and China

ITALY		CHINA	
THEME	SUB-THEME	THEME	SUB-THEME
Cultivating female STEM interest	STEM activities	Cultivating female STEM interest	Female scientist role models
	Multi-body		STEM activities
	Propagation		STEM competitions
	Upgrading courses		Women's scientific literacy
Academic support	Upgrading courses	Academic support	International academic exchanges
			Subject base

			Frontier science centre
			Cultivating top female talent
			Multi-level
Widening access	Gender reserve	Access to justice	Enrolment supervision
			Unequal punishment
			STEM incentive measures
Financial support	Scholarships	Financial support	Scholarships
Gender in research	Gender dimension	Gender in research	STEM and gender
	Gender data		STEM and gender research programmes
Gender and education	Gender equality courses	Gender and education	Gender equality course
	Textbooks		Textbooks
	Teacher training		Teacher training
	Teaching processes		Teaching processes
	Gender neutral grammar		Female education rights
	Pedagogical innovation		Gender mainstreaming
	Interdisciplinary approaches		
Structural gender equality	Evaluation		
	Gender quotas		
	Gender equality language		
Female guidance	STEM choice	Female guidance	Professional guidance
	Eliminating gender stereotypes		Eliminating gender stereotypes
	Shadowing programme		Female academicians' guidance
Gender funding	Gender quotas		
	Unequal sanctions		
	Equal rewards		

Table 20. Total Implementation of Gender Equality Policy in STEM HE

THEME	SUB-THEME
Cultivating female STEM interest	STEM activities
	Multi-body
	Propagation
	Upgrading courses
	Female scientist role models
	STEM competitions
	Women's scientific literacy
Academic support	Upgrading courses
	International academic exchanges

	Subject base
	Frontier science centre
	Cultivating top female talent
Widening access	Multi-level
Access to justice	Enrolment supervision
	Unequal punishment
	STEM incentive measures
Financial support	Scholarships
Gender in research	Gender dimension
	STEM and gender
	STEM and gender research programmes
Gender and education	Gender equality courses
	Textbooks
	Teacher Training
	Teaching process
	Gender neutral grammar
	Pedagogical innovation
	Interdisciplinary approaches
	Female education rights
	Gender mainstreaming
Structural gender equality	Evaluation
	Gender quotas
	Gender equality language
Female guidance	STEM choice
	Eliminating gender stereotypes
	· Shadowing programmes
	Professional guidance
	Eliminating gender stereotype
	Female academicians' guidance
Gender funding	Gender quotas
	Unequal sanctions

3.3.3 Vulnerability: Does Policy Aim to Widen Access to Education and Promote Full Participation and Opportunities for Women Vulnerable to Exclusion to Realise Their Potentials?

As Council of Europe plan to Contribution to the UN Sustainable Development Goals 4.5 Gender equality and inclusion presented: by 2030, eliminate gender disparities in education and

ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations.

Female gender always been viewed as one of a vulnerable group ·so when it turn to vulnerability in this chapter, it refers to the intersectional vulnerability besides gender.

A review recently revealed that the Athena Swan Charter recognizes and supports efforts to advance women's careers in STEM, but results in a narrow definition of equity and inclusion that disproportionately benefits white, middle-class women, and failing to address the impact of other aspects of identity - such as race, disability, sexual orientation, and socioeconomic status - on the system in which we live (Graves et al., 2022; Jebsen et al.,2022; Kalwant & Holly 2021).

There are two themes being recognized in the Chinese policies on gender equality in STEM concerned vulnerability: vulnerability type and supporting way. The vulnerable type being mentioned is the women in poverty. As a developing country, the development in China is un-balanced, especially when compared between urban and rural areas, the rural areas is more difficult in achieving gender equality. On this basis, the policies suggested that more efforts should be made to ensure the livelihood of women. However, the efforts only concerned livelihood and is too roughly without mention the specific way which can be difficult for implementing.

Table 21. Themes of Vulnerability Mentioned in Policies in China

POLICY TEXT	SUB-THEME	THEME
There are gaps in women's development between urban and rural areas, regions and groups, and more efforts should be made to ensure the livelihood of women in less developed areas, especially in less developed areas (Policy 2).	More efforts should be made for women in poverty.	Vulnerability type ，Supporting way

Refer to the themes recognized in Italian policies concerned Vulnerability. The sub-themes vulnerability type and supporting way are recognized.

Under the theme "vulnerability Type", the types for women who may be recognised as vulnerable include poverty, disability, poverty, violence, labour exploitation, gang mastering,

ethnicity, religion, personal beliefs and sexual orientation, and student mother.

The "supporting way" to women in vulnerabilities including mainstreaming women in vulnerabilities, such as disability, poverty, violence, labour exploitation and gang mastering, female student mothers at university got support from tuition fees, course, and exams; gender equality observatory should relate to women with disabilities.

According to different type of vulnerabilities, the supporting methods are different. Policy 6 proposes supporting women in vulnerable positions through mainstreaming the gender perspective associated with vulnerabilities, such as disability, social and economic hardship, violence, labour exploitation and gangmastering, in the design of strategic measures and the adoption of specific measures for vulnerable targets. In Policy 8, when discussing the Observatory on gender equality, it mentions that 'one point to focus on in the work (on monitor gender equality) of this Observatory should relate to women with disabilities. In Policy 11, although there is no mention of specific measures for vulnerable women, other factors such as disability, ethnicity, religion, personal beliefs and sexual orientation are cited as factors that, along with gender, may contribute to multiple forms of discrimination. In addition, Policy 6 specifically refers to the protection of the rights and interests of student mothers as well as other disadvantaged women in higher education. For female student mothers at university, from the time they get pregnant until the early months or years of their child, according to Policy 6, exemption from the payment of tuition fees and suspending the calculation of course years are provided, while still guaranteeing them the opportunity to attend classes and take exams.

Table 22. Themes of Vulnerability Mentioned in Policies in Italy

POLICY TEXT	SUB-THEME	THEME
Supporting women in vulnerable positions through mainstreaming the gender perspective associated with vulnerabilities, such as disability, social and economic hardship, violence, labour exploitation and gangmastering, in the design of strategic measures and the adoption of specific measures for vulnerable targets. (Policy 6)	Mainstreaming women in vulnerabilities, such as disability, poverty, violence, labor exploitation and gang mastering	Vulnerability type. Supporting way.
For female student mothers at university, from the time	Female student mothers at university got	Vulnerability type.

they get pregnant until the early months or years of their child, exemption from the payment of tuition fees and suspending the calculation of course years are provided, while still guaranteeing them the opportunity to attend classes and take exams. (Policy 6)	support from tuition fees，course，and exams.	Supporting way.
One point to focus on in the work (on monitor gender equality) of this Observatory should relate to women with disabilities (Policy 8)	Gender equality observatory should relate to women with disabilities	Vulnerability type. Supporting way.
Other factors such as disability, ethnicity, religion, personal beliefs and sexual orientation are cited as factors that, along with gender, may contribute to multiple forms of discrimination (Policy 11)	Other factors along with gender, may contribute to multiple forms of discrimination.	Vulnerability type.

3.3.4 Framework: Is There a Long-term, Multi-level Policy Framework for Implementing Quality Gender Inclusive Education at National, Regional and/or Organisational levels?

Table 23. Comparing the Framework of Policies from Italy and China

ITALY		CHINA	
Content	Gender equality in education	Content	Gender equality in education
	Gender equality at university		Gender equality in STEM
	STEM education		
	Student guidance		
Multi-level	Education level	Multi-level	Education level
	Structural level		Institution level

Table 24. Total Framework of Policies on Gender Equality in STEM HE

THEME	SUB-THEME
Multi-level	Education level
	Institution level
	Structural level
Content	Gender equality in education
	Gender equality at university
	Gender equality in STEM
	Student guidance
	STEM education

There are two themes recognised that form the policy framework for implementing quality gender-inclusive education, which are multi-level and content. Eight sub-themes are also recognised. The main themes recognised are shared, but they differ in terms of sub-themes. Under the multi-level theme, the sub-theme education level is shared but there is a difference in that Italian policy has the tendency of making structural level changes unlike the Chinese policy. In terms of the content, the Italian policy chooses to promote STEM education, student guidance plans and gender equality in universities while Chinese policies focus more on gender equality in STEM fields.

In Chinese policy, human rights education, gender equality in education and gender equality in STEM are recognised as sub-themes. With regard to the sub-theme of human rights education, this is stated in Policy 1 by explaining that 'human rights education has been incorporated into the national education system, human rights research has been conducted, human rights training has been strengthened, human rights knowledge has been popularised, and awareness of respecting and protecting human rights has been raised in the whole of society'. Concerning the sub-theme of gender equality in education, Policy 2 stipulates 'comprehensive promotion of gender equality education in universities and primary and secondary schools to promote the enhancement of gender equality awareness'. This means the policy aims to enhance gender equality awareness through different levels. Concerning the theme of gender equality in STEM, it is stipulated in Policy 3 that 'the training of female reserve scientific and technological personnel should be strengthened'.

In Chinese policy, education level and institutional level are recognised as the sub-themes of the multi-level theme. For the education level sub-theme, there are different requirements on how to carry out gender equality actions at different levels of education based on the different roles that different levels of education can play. Policy 1 mentioned about School human rights education. The different education levels related to human rights education include human rights education in primary and secondary schools and higher education institutions conducting human rights general education and professional personnel training, as well as national human rights education and training base education. Policy 1 describes that it is necessary to 'carry out

lively and diverse forms of human rights education at all levels and in all types of schools so that students can firmly establish a sense of human rights. This includes strengthening human rights education in primary and secondary schools, integrating human rights knowledge such as valuing life, awareness of equality, protection of privacy and the rights and interests of minors into the relevant curricula of primary and secondary schools, enriching educational methods and means, expanding educational practices and promoting the popularisation of human rights knowledge in primary and secondary schools in a lively form ... Colleges and universities are encouraged to carry out general human rights education and professional personnel training, continue to support institutions of higher learning to set up human rights-related professional courses and general courses, and compile human rights-related teaching materials, strengthen the construction of human rights disciplines and personnel training, and explore the establishment of human rights teacher training centres in normal colleges and universities … The establishment of national human rights education and training bases should be supported. We will strengthen the construction of national human rights education and training bases and add three more, exploring the construction of an international human rights education exchange centre based on national human rights education and this training base." Policy 2 sets out policies to promote gender equality in education. It is stipulated in Policy 2 that there should be 'comprehensive promotion of gender equality education in universities and primary and secondary schools to promote the enhancement of gender equality awareness'. The promotion of gender equality education is to be conducted through universities, primary schools and secondary schools, which are different levels of education. Under the theme of strengthening the training of female reserve science and technology talents in Part VI of Policy 4, a framework for gender equality education in STEM is deployed differently at primary and secondary school, high school and university levels. Its gender equality education framework concerning STEM includes 'improving the participation of female students in primary and secondary schools to improve various science education bases and science popularisation activities' and 'encouraging and supporting female students to participate in science and technology competitions for primary and secondary school students ... Senior high school

education should strengthen the guidance of female students' subject choices and career development while eliminating the adverse influence of gender stereotypes on female students' choices of major ... Career development planning should be strengthened for female students of science and engineering, with more female students guided to choose scientific research as a lifelong career.' Such a deployment covers all stages from K12 to employment, forming an overall framework by acting on the various stages of the development of interest, the selection of a profession and the selection of a career. It is stated in Policy 3 that the promotion of female students in STEM should be conducted from K12 education to the higher education level. Having many kinds of science popularisation education bases and activities could increase the participation of female students in primary and secondary schools. Female students are thus encouraged and supported to participate in science and technology competitions among primary and secondary school students.

In the institution level sub-theme, the policies are conducted by different institutions. Since Policy 3 and Policy 4 are measures taken to promote gender equality in STEM, they not only relate to national governments, regional governments and higher education institutions but also administrative bodies related to science and technology development and women's development. Policy 3 stipulates, 'Women's federations at all levels, science and technology departments (committees and bureaus), SASAC, trade unions, units of the Chinese Academy of Sciences, and units of the Academy of Engineering shall carry out actions for science and technology innovation among women as an important action for implementing the strategy of science and education to revitalise the country, the strategy of talent development and the strategy of innovation-driven development. As an important focus for gathering women's scientific and technological strengths to fight for a new journey, we should give full play to our organisational advantages, effectively strengthen leadership, clarify goals and tasks, and carefully deploy and implement them. It is necessary to innovate ideas, strengthen coordination and interaction, win the support of local party committees, governments and all parties, and creatively carry out work. Social organisations such as women's science and technology associations, women's doctors' associations and women's enterprise associations at all levels

should give full play to their professional advantages and resource advantages and jointly implement scientific and technological innovation actions and achieve results through a variety of solid and effective services.' Policy 3's content shows that the institutions implementing Policy 3 and formulating detailed measures to promote the implementation of Policy 3 include women's federations at all levels, science and technology departments (committees and bureaus), SASAC, trade unions, units of the Chinese Academy of Sciences and the Chinese Academy of Engineering. Social organisations such as the Women's Association of Science and Technology, the Women's Medical Association and the Women's Enterprise Association, with the participation of all administrative units, women's groups and social organisations, aim to form a joint force for gender equality measures in STEM fields and an environment in which the talents of female technicians can be fully displayed. In policy practice, universities, local governments, local science associations and other organisations have formulated detailed and special policies on Policy 3 and Policy 4 initiatives. For example, the Shanghai Municipal government issued the Women's Action in Science and Technology Innovation · Shanghai Declaration. Furthermore, Shanghai Jiao Tong University has supported female scientific and technological talents in playing a greater role in science and technology innovation with 16 measures (Shanghai Jiao Tong, 2022, No. 1). Meanwhile, the Shanghai Women's Federation and the Municipal Science and Technology Party Committee as well as nine other departments jointly issued the Science and Technology Innovation Women's Action - Shanghai Declaration. Here, the Shanghai Women's Federation, together with 17 departments and units such as the Municipal Science and Technology Party Committee and the Municipal Science and Technology Commission, issued several measures to support female scientific and technological talents in playing a greater role in Shanghai's construction of a science and technology innovation centre with global influence. The Ningbo Science and Technology Bureau, together with the Municipal Women's Federation, issued a notice regarding several measures to encourage and support female scientific and technological talents in playing a better role in Ningbo (Yongke Foreign, 2023, No. 70). Each local administrative body has formulated detailed policies and promulgated policies to form an overall policy framework.

In terms of Italian policies, the content and multi-level themes can be recognised. Under the content theme are the sub-themes of gender equality education, gender equality universities, student guidance and STEM education. The gender equality education sub-theme is mentioned in Policy 6, which states that the principle of gender equality should be promoted at all levels of education. Policy 8 also proposes educational methods, especially innovative educational methods, that contribute to gender equality in STEM fields in early childhood, primary school, secondary school and university. Policy 11, meanwhile, provides a comprehensive gender equality education framework that aims to eliminate the influence of gender stereotypes. The STEM education sub-theme is mentioned in Policy 7, which aims to strengthen the conditions for the development of a knowledge-intensive, competitive and resilient economy, while the PNRR aims to support the development of STEM skills and digital skills to prepare for a competitive future. In Investment 3.1 New Skills and New Languages, the measure aims to 'promote the integration, within the curricula of all school cycles, of activities, methodologies and contents aimed at developing STEM, digital and innovation skills, with particular attention to equal opportunities'. The student guidance sub-theme is mentioned in Policy 7 and Policy 10, which aim to provide life-oriented guidance to help students realise their talents. The gender equality at university sub-theme is discussed in Policy 9. While gender equality is referenced in other policies, Policies 9 and 12 show a comprehensive framework for structural change for a future of gender equality in higher education institutions.

The education level and structural level are also recognised in the Italian policy framework. With regard to the different education levels, they are organised under the content of gender equality education, STEM education and student guidance. For gender equality education, the framework is provided during different levels of education. Policy 11 recommends a different standard and action plan for gender equality education at deferent levels. However, the standards and directions for higher education are missing as they describe 'accepting and welcoming diversity, understanding the reasons and above all using them as a resource for solving problems, performing tasks and the development of projects; taking care of your language, avoiding improper and offensive expressions' (primary school), 'identifying the

elements that contribute to defining one's identity and strategies to harmonise any contrasts that characterise them' (lower secondary school) and 'identifying ethnic, social and cultural stereotypes and prejudices present in one's own attitudes and behaviours and those of others, in the mass media and in study and research texts' (upper secondary school). However, Policy 6 suggests in terms of action the 'promotion of positive role models for gender equality and for the deconstruction of gender stereotypes as well as the fight against hate speech and discrimination through educational initiatives in schools and universities and dedicated communication campaigns'. This means the place for gender equality education should include schools and universities as well as dedicated communication campaigns. The goal, content and form of gender equality education at the tertiary education stage are established in this policy. Policy 8 sets out ways to promote women's participation in STEM at all stages of education. For early childhood, there is an aim to 'introduce learning methods from early childhood based on play and experimentation, curiosity and problem-solving as an introduction to the scientific method' (Policy 8). For all levels of compulsory education, there is an aim of 'continuing education for teachers in science and mathematics, starting from elementary school, as well as training in digital updating and raising awareness of gender stereotypes; promoting the importance of STEM training for girls with respect to the professions of tomorrow, and the central role that knowledge/skills in these sectors have in building the future (environmental problems, energy, sustainable development, health)'. There are also aims to reform the requirements for publishing and/or recommending the purchase of schoolbooks for primary and secondary schools, which is to ensure that they do not promote gender stereotypes (Policy 6). For high school students, there is an aim for the allocation of funds for voluntary upgrading courses in scientific and mathematical disciplines (Policy 6) while strengthening teaching in mathematical disciplines through extracurricular hours of compulsory maths (Policy 6). It also aims to 'strengthen individual educational guidance services to promote access to STEM studies in middle school and high school', enhancing psychological support programmes such as school psychologists or provincial guidance offices (Policy 6). In higher education, there is an aim for the 'introduction of gender quotas in the gender-neutral evaluation of academic

performance' (Policy 6) and 'establishing postgraduate and postdoctoral scholarships in STEM fields specifically aimed at women, to be awarded on the basis of the value of the research project' (Policy 8).

With regard to promoting STEM education, the policies on strengthening STEM skills are mostly for all school levels while only some of them are for specific levels of school. Policy 8 calls for promoting the importance of STEM training for girls with respect to the professions of tomorrow and the central role that knowledge or skills in these sectors have in building the future such as addressing environmental problems, energy, sustainable development and health. In all levels of schools, there is an aim to 'create in schools a scientific culture and the mindset necessary for a different approach to scientific thinking, specifically focused on STEM teachings such as inquiry-based learning (IBL) and problem-solving, with the use of teaching actions not only based on frontal lessons'. There is also an aim to pay particular attention to 'carrying out the actions described dedicated to fully overcoming stereotypes' (Policy 7). Furthermore, 'a strong STEM basis is preparatory to more applied knowledge of digital tools, therefore it is essential to enrich primary and secondary schools with quantitative-based courses, with related examples of digital tools' (Policy 7). Meanwhile, all schools should focus on 'strengtheningSTEM education, increasing the minimum number of computer science hours (including code learning)' (Policy 6). There is also a specific mention of 'funding extra-curricular (e.g., afternoon) computer science courses to obtain certifications (e.g., ECDL) in high schools' (Policy 6).

For student guidance, Policy 10 was adopted following the Decree no 328 of the minister of education and merit of 22 December 2022 concerning the adoption of the guidelines for guidance on Reform 1.4, namely the reform of the guidance system, as part of Mission 4 Component 1 of the national recovery and resilience plan, whereby '4.3 Orientation begins, starting from nursery and primary school, as a support for confidence, self-esteem, commitment, motivation and recognition of talents and aptitudes while also encouraging the overcoming of difficulties present in the learning process (…) 5.1 In secondary education paths, effective orientation, according to the indications shared at the European level, requires a stronger

emphasis on the development of basic and transversal skills (responsibility, spirit of initiative, motivation and creativity, which are also fundamental for promoting youth entrepreneurship), learning foreign languages, (...) improving learning levels in the workplace and establishing excellent professional education and training systems; the permeability of qualifications and the recognition of skills acquired outside professional education and training courses; an increasing use of digital technologies to facilitate learning through open and collaborative educational resources; the presence of trained and motivated teachers; (...) closer integration between education, professional training, higher education, universities and businesses (...) Upper secondary schools will, starting from the 2023-2024 school year, activate: student training orientation modules of at least 30 hours including extracurricular study per school year in first and second grades; curricular modules for student training orientation of at least 30 hours per school year in third, fourth and fifth grades for promoting positive orientation from high school to college.'

In terms of high school, strengthening individual educational guidance services is to promote access to STEM studies (Policy 6), while enhancing psychological support programmes, such as school psychologists or provincial guidance offices, aimed at providing aptitude guidance, overcoming gender stereotypes and focusing on how girls consider STEM disciplines and the influence of cultural and family backgrounds on academic and career choices (Policy 6). There is also an aim to strengthen ministerial and school activities to guide high school students through university and employment, especially directed at encouraging career development for women in the STEM and technological fields (Policy 6). According to the PNRR (Policy 7), the guidance reforms are to be implemented through the introduction of orientation modules, approximately 30 hours per year, in lower and upper secondary schools. This is to encourage the raising of education levels and the creation of a digital orientation platform relating to tertiary training offers from universities and professional training institutes (ITS). Furthermore, an active orientation regarding the school-university transition strategy is conducted in Reform 1.6 of Policy 7, which 'contributes to the quality of the education system through an increase in success indicators and the mitigation of gender gaps, both in terms of employment and

participation in higher education in all fields'. However, with regard to Policy 10, which is a policy to implement providing guidance for students in school, gender is not included as a variable and there is no guiding advice concerning eliminating gender stereotypes in this policy. As mentioned in 12.2 in Policy 10, the PNRR (Policy 7) allows the activation of many paths and interventions to promote orientation within 'various investment lines …owned by the Ministry of Education and Merit …which offers the possibility of carrying out orientation activities, with highly innovative content, towards studies and professional careers in the STEM disciplines (science, technology, engineering and mathematics) in all first and second-year schools cycle'. Policy 7 mentions making donations to STEM studies. However, in Policy 7, when STEM discipline intervention is discussed, it focuses on 'particular attention being paid to carrying out the action described, which is also dedicated to fully overcoming stereotypes'. This means enhancing STEM education in that it should also address gender stereotypes. Furthermore, in terms of the upper secondary school orientation mentioned in Policy 10, which will 'activate starting from the 2023-2024 school year to supply student training orientation modules of at least 30 hours including extracurricular study per school year in first and second grades, and curricular modules for student training orientation of at least 30 hours per school year in third, fourth and fifth grades', gender is also missing. Policy 6 is designed to encourage females to develop careers in STEM with guidance in high school while Investment 1.6 of Policy 7 aims to increase success indicators and the mitigation of gender gaps, both in terms of employment and participation in higher education in all fields. Policy 10, however, does not mention anything related to gender. The guidance for active movement from school to universities is related to 12.3 of Policy 7, which discusses a collaboration between the Ministry of University and Research and the Ministry of Education and Merit being activated within the PNRR, specifically investment line 1.6. This allows all second cycle secondary schools to be able to carry out orientation courses of 15 hours each in the third, fourth and fifth classes. Policy 7 also does not specifically mention guidance for promoting females in STEM, unlike Policy 6, which is part of the implementation of PNRR (Policy 7). While Policy 9 is the policy for student guidance, which aims for life-long guidance, only the period from childhood to entering higher

education is discussed, with nothing on higher education. Furthermore, for the guidance before higher education, it does not mention eliminating gender stereotypes. The missing gender content of Policy 10 is not inconsistent with the other policies that especially discuss eliminating gender stereotypes through guidance, such as in Policy 6.

In terms of promoting gender equality university, this is focused on structural change, which focuses on different levels in a structure, meaning a structural level sub-theme can be recognised. Gender equality at universities is led by the Gender Equality Plan (GEP). The GEP is a mandatory document for higher education institutions to apply for EU funding projects and it provides a clear framework for structural change in the sector. First is the adoption of generic gender equality objectives or the adoption of an anti-discrimination strategy that mentions gender in the context of other types of diversity, which does not in itself meet the requirements for the GEP. For example, the mere inclusion of a chapter on gender in a Sustainability Report, which many universities also draw up periodically, cannot be considered sufficient. Moreover, the GEP consists of three main objectives focusing on the areas of intervention, the objectives and the individual measures and the content of five squares, including the balance of private life and work life and organisation culture, gender balance in top positions and in decision-making bodies, gender equality in recruitment and in career progression, integration of the gender dimension in research and in teaching programmes, and tackling gender-based violence, including sexual harassment. Therefore, in essence, the content of promoting gender equality at university is guided through a five-part framework of culture, power, work, study and gender-based violence based on a GEP with four characteristics as a public document, with specific funding, monitoring data and gender training for conducting the GEP.

3.3.5 Needs: Does Policy Outline How Provisions Are Provided for Learners Following the Identification of Need?

"Meet the new, reality needs of human right protection" sub-themes are mentioned under the theme "feature of need" in Policy 1, which aims 'to meet the new needs of the people for human rights protection as the direction of struggle, and to integrate the universal principles of human

rights with the reality of China'. With regard to the theme "collecting and monitoring statistics", the type of statistics being collected is data concerned "female STEM talents". With Policy 4 stipulating that 'a data index system for female scientific and technological talents should be established to be included in national science and technology statistics', the data should be collected and monitored through building a data index system included in national science and technology statistics.

The sub-themes under "conducting research" to identify the need of female STEM talent including, the research theme include 'to conduct a gender assessment of science and technology policies' and 'to carry out follow-up research on female STEM talents". As is mentioned in policy 4, "carry out follow-up research on the growth of female scientific and technological talents and provide support for further improving policies for female scientific and technological talents", the aim of carry out the follow-up research is to providing statistics for further improvement of female scientific and technological talents. With regard to the sub-theme "special policies that meet the characteristics of female scientific" and "technological talents and full consideration should be given to gender differences and women's special needs", it describes the features that the need should meet the STEM female talents characters. As policy 3 states that 'special policies that meet the characteristics of female scientific and technological talents are insufficient' and that 'in formulating scientific and technological innovation plans and relevant policies at all levels, full consideration should be given to gender differences and women's special needs, and … special arrangements should be made to strengthen the construction of female scientific and technological personnel'.

Table 25. Themes Concerned Identification of Need in Policy from China

POLICY TEXT	SUB-THEME	THEME
To meet the new needs of the people for human rights protection as the direction of struggle, and to integrate the universal principles of human rights with the reality of China. (Policy 1)	Meet the new, reality needs of human right protection	Features of need
Special policies that meet the characteristics of female scientific and technological talents are insufficient'. (Policy 3)	Special policies that meet the characteristics of female scientific and technological talents	Features of need

In formulating scientific and technological innovation plans and relevant policies at all levels, full consideration should be given to gender differences and women's special needs, and … special arrangements should be made to strengthen the construction of female scientific and technological personnel' (Policy 3).	Full consideration should be given to gender differences and women's special needs	Features of need
A data index system for female scientific and technological talents should be established to be included in national science and technology statistics (Policy 4).	Established a data index system for female STEM talents	Collecting and monitoring statistics
It is necessary 'to conduct a gender assessment of science and technology policies' and 'to carry out follow-up research on the growth of female scientific and technological talents and provide support for further improving policies for female scientific and technological talents' (Policy 4).	STEM female statistics	Collecting and monitoring statistics
	To conduct a gender assessment of science and technology policies	Conducting research
	To carry out follow-up research on female STEM talents	Conducting research

There are three themes being recognized on the policy about identifying need in Italian policies: collecting and monitoring statistics, policy assessment, and features of need. In regards to the theme collecting and monitoring statistics, the sub-themes including collect gender statistics covering different areas, reinforcing gender in statistics, define objectives and monitor their achievement through adequate indicators, university statistics disaggregated by gender, observation of gender equality, statistics available to favour the match between students' skills and job demand, monitoring implementation, through the data collected, included parameters of numbers of teacher, researcher and technical-administrative, gender budget tools, creation and use of sex-disaggregated data.

The way to collecting and monitoring statistics including reinforcing gender in statistics sub-theme refers to reinforcing gender perspectives on the basis of the original databases, which is described using 'ISTAT and SISTAN to reinforce the development of gender statistics and research [to] help collect increasingly detailed gender statistics covering different areas' (Policy 6). The "university statistics disaggregated by gender" sub-theme relates to a belief that gender statistics regarding students and staff should be collected. As Policy 9 states, 'the data must be disaggregated by gender and related both to the student population and to the teaching, research

and technical, administrative and librarian staff; an updated annual report must also be prepared with indicators available on the site'. Therefore, the gender equality plan used for constructing the gender equality strategy should base on its own needs according to the policy guide (Policy 9). Policy 12 suggests to "creation and use of sex-disaggregated data". This suggestion means that the collection of gender-disaggregated data should be encouraged in research and education areas, as well as the creation and use of new gender-disaggregated data in research samples and scientific studies. Through this way, the research and education can be conducted in a way that pay attention to the gender characters. What's more, Policy 9 mentions that data in universities should be monitored, and it includes the sub-themes of observation of gender equality, gender equality level gender impact and before and after. In Policy 8, the way to identify need is to monitor and the monitoring body is the observatory on gender equality. The targets of monitoring include legal initiatives and policies. The content of the monitoring statistics includes the gender equality level and the gender impact of measures while there are before and after stages. With regard to the gender budget tool sub-theme, a gender budget tool is recommended to monitor the development of gender equality (Policy Proposal 12). The European Parliament resolution of 3 July 2003 (2002/2198(INI)) already envisaged the gender budget as a tool for equality bodies and the international community to promote gender equality issues. CURI published the Budget Guide for Gender Equality for Italian Universities in 2019. Under the research and education theme, it is recommended to monitor the presence of research facilities on gender issues and teaching and training initiatives (Policy Proposal 12). Under the STEM degrees plan theme, it is recommended to monitor the conducting of STEM degree plans with regard to promoting females in STEM. In the face of the abstractness and universality of gender equality policy and the principle of equal opportunities, one should pay attention to different levels in terms of how to make policies truly meet the needs of promoting a gender-inclusive environment in the implementation process, regardless of data statistics, policy monitoring or research. Policy 6 aims to 'help collect increasingly detailed gender statistics covering different areas'. Meanwhile, Policy 11 states that 'The declination of the principles of equal opportunities, as well as the lines of intervention, must take into account the different

levels of education, the age of the pupils, the school curriculum, of the different disciplinary areas involved, and of the project lines'. Public and private subjects mean that 'all subjects' and 'all initiatives' including 'any legislative, political, strategic or programmatic initiative' should be monitored (Policy 7, Policy 8).

Refer to the theme "policy assessment", the sub-themes gender impact assessment is mandatory and monitor the implementation of STEM orienting initiatives are recognized. The policy assessment theme includes the sub-themes of gender influence, all initiatives and mandatory. The gender influence sub-theme discusses 'analysis which could indicate which areas are relevant for gender equality and what the expected impact on gender equality is, laying the groundwork for an in-depth analysis of the most affected stakeholders and measuring (expected and actual) effects'. There are also assessment factors like economic impact assessments. Policy 6 reveals that 'in addition to economic impact assessments, a gender impact assessment is mandatory as a methodology for the design and analysis of every legislative, regulatory and political initiative'. "Every legislative, regulatory and political initiative' as proposed in Policy 6, which explains it is 'a methodology for the design and analysis of every legislative, regulatory and political initiative'. The mandatory sub-theme is discussed in Policy 6, where assessment is mandatory. Gender impact assessments may be introduced to all legislative initiatives. To make the ex-ante gender impact assessment method transversal and structural, the introduction in all parliamentary committees, in addition to economic impact assessments, of a mandatory gender impact assessment is needed as a methodology for the design and analysis of every legislative, regulatory and political initiative. By identifying regulatory, principle and implementation issues, this analysis may indicate which areas are relevant for gender equality and what the expected impact on gender equality is, thus laying the groundwork for an in-depth analysis of the most affected stakeholders and measuring the expected and actual effects.

Concerned the theme "features of need", the sub-themes "differing from the environment", "identify gender distortions" and "inequalities and the declination and intervention of the principles of equal opportunities base on reality are recognized" are included.

Policy 9 describes how 'processes for gender equality must intercept the specificities of local contexts and respond to them through appropriate methods, respecting the differences and diversities that make each context unique'. As mentioned in Policy 9, 'the gender equality plan is defined by the European Commission as a strategy to identify gender distortions and inequalities; implement innovative strategies to correct distortions and inequalities; define objectives and monitor their achievement through adequate indicators'. The feature of the need should be focused on gender distortions and inequalities. The identification of gender distortions and inequalities is useful for recognising obstacles that play an important role in implementing innovative strategies.

Table 26. Themes Concerned Identification of Need in Policy from Italy

POLICY TEXT	SUB-THEME	THEME
Help collect increasingly detailed gender statistics covering different areas (Policy 6).	Collect gender statistics covering different areas	Collecting and monitoring statistics
In addition to economic impact assessments, a gender impact assessment is mandatory as a methodology (e design and analysis of every legislative, regulatory, and political initiative) (Policy 6).	Gender impact assessment is mandatory	Policy assessment
Processes for gender equality must intercept the specificities of local contexts and respond to them through appropriate methods, respecting the differences and diversities that make each context unique (Policy 9).	Differing from the environment	Features of need
The gender equality plan is defined by the European Commission as a strategy to identify gender distortions and inequalities; implement innovative strategies to correct distortions and inequalities; define objectives and monitor their achievement through adequate indicators (Policy 9)	Identify Gender distortions and inequalities	Features of need
	Define objectives and monitor their achievement through adequate indicators	Collecting and monitoring statistics
Reinforcing gender perspectives on the basis of the original databases, which is described using 'ISTAT and SISTAN to reinforce the development of gender statistics and research [to] help collect increasingly detailed gender statistics covering different areas' (Policy 6).	Reinforcing gender in statistics	Collecting and monitoring statistics
The data must be disaggregated by gender and related both to the student population and to the teaching, research and technical, administrative and librarian staff; an updated annual report must also be prepared with indicators available on the site'. The gender equality plan is a tool used for constructing the gender equality strategy on the	University statistics disaggregated by gender	Collecting and monitoring statistics

basis of its own needs. (Policy 9)		
Establish an Observatory on gender equality at the Department for Equal Opportunities to monitor the level of gender equality of public and private subjects, also in order to introduce ex ante and ex-post gender impact assessment at the institutional level as an ordinary practice in the design phase of any legislative, political, strategic or programmatic initiative, as well as to define a three-year strategic plan for gender equality. One point to focus on in the work of this Observatory should relate to women with disabilities. (Policy 8)	Observation of gender equality	Collecting and monitoring statistics
To support orientation, each educational institution, within its organizational and financial framework, identifies a figure who, in managing the data provided by the Ministry referred to in point 10.1, takes care of refining and integrating them with the specific data collected in the different local economic realities, so as to make them available to teachers (in particular tutor teachers), families and students, also with a view to facilitating the continuation of their studies or entry into the world of work. In this context, educational institutions favor the match between students' skills and job demand. (Policy 9)	Statistics available to favor the match between students' skills and job demand	Collecting and monitoring statistics
These guidelines are subject to specific monitoring of their implementation, through the analysis of data collected by the information system of the Ministry of Education and Merit and related platforms, on an annual basis, on the basis of specific implementation indicators. (Policy 9)	Monitoring implementation, through the data collected.	Collecting and monitoring statistics
The declination of the principles of equal opportunities, as well as the lines of intervention, must take into account the different levels of education, the age of the pupils, the school curriculum, of the different disciplinary areas involved, and of the project lines (Policy 11).	The declination and intervention of the principles of equal opportunities base on reality	Features of need
It is essential that indicators are included among the evaluation parameters of the Universities and Departments on initiatives on gender balance in the University's research environment in the numbers of teacher, researcher and technical-administrative. In particular, it is suggested that the following be measured: the horizontal and vertical integration of staff at all levels; the existence and results obtained of centres dedicated to the study of the dynamics of gender within individual disciplines; the existence and results obtained of interdisciplinary centers for the study of gender a departmental, interdepartmental, University level; participation in inter-university centres, consortia or observatories on the issues of genre, as well as international collaborations; the dissemination of dedicated teachings in degree courses and post-graduate training courses degree; initiatives to promote gender equality regarding the	Included parameters of numbers of teacher, researcher and technical-administrative.	Collecting and monitoring statistics

third mission of the University in relation to territorial and associative realities (Policy Proposal 12).		
A gender budget tool is recommended to monitor the development of gender equality (Policy Proposal 12)	Gender budget tools	Collecting and monitoring statistics
Encourage the creation and use of sex-disaggregated data in the context of research and education, and the creation and use of new disaggregated data for sex in samples used for scientific studies. (Policy Proposal 12)	Creation and use of sex-disaggregated data	Collecting and monitoring statistics
Monitor the implementation of the Scientific Degree Plan 2017 – 2018 in relation initiatives aimed at orienting female students towards the disciplines STEM (Policy Proposal 12).	Monitor the implementation of STEM orienting initiatives	Policy assessment

Table 27. Themes and Sub-themes on Identification of Need in Policy from Italy

THEME	SUB-THEME
Collecting and monitoring statistics	Collect gender statistics covering different areas
	Reinforcing gender in statistics
	Define objectives and monitor their achievement through adequate indicators
	University statistics disaggregated by gender
	Observation of gender equality
	Statistics available to favor the match between students' skills and job demand
	Monitoring implementation, through the data collected.
	Included parameters of numbers of teacher, researcher and technical-administrative.
	Gender budget tools
	Creation and use of sex-disaggregated data
Policy assessment	Gender impact assessment is mandatory
	Monitor the implementation of STEM orienting initiatives
Features of need	Differing from the environment
	Identify Gender distortions and inequalities
	The declination and intervention of the principles of equal opportunities base on reality

IV. EXPERT KNOWLEDGE ON ENHANCING THE GENDER INCLUSIVE ENVIRONMENT IN STEM IN HIGHER EDUCATION

This chapter is based on the empirical data mainly from expert interviews, from a practical perspective, to deepen the knowledge of the challenges and directions on policies on promoting gender inclusive, equitable quality STEM higher education. The expert panel is constructed by 5 experts from Italy, China, the United States, Denmark and Slovakia, who are the drafters and implementor of gender equality plan in STEM universities, the coordinator of projects in universities aimed at promoting the development of female STEM students, professors and researchers from higher education institutions who have been observed and conducted research on gender equality in STEM for many years. Using the ATLAS.ti software, this thesis employs thematic analysis to examine the data collected through expert interviews. After iterative analysis of experts' ideas, three themes have emerged. These encompass the description of characteristics and manifestations of gender inequality in HE, the sharing of challenges and advancements in policies and practices fostering gender equality within STEM institutions, and recommendations for advancing gender equality in STEM in HE across both national and institutional levels.

4.1 Explanation: Gender Inequality in STEM in Higher Education

There are 6 themes that can be recognized to elucidate gender inequality in STEM in HE. The 6 themes including gender segregation, social problem, structural problem, educational problem, contextualized, and vague attitude.

Table 28. Themes and Sub-themes of Gender Inequality in STEM in Higher Education from Expert Interview

EXPERT IDEA	SUB-THEMES	THEMES
There is a sexist division that leads male students to pursue subjects considered masculine (science and technology) and female students to	There is a sexist division through gendering subjects	Gender segregation

pursue so-called feminine ones (liberal arts) (Expert 5)		
In Italian high school, the gender segregation is already very significant (68.9% of boy students enrolled with a prevalence for the technological sector which sees 81.5% of male students enrolled; furthermore, boys prevail in professional institutes for industry and crafts (77.3%)) (Expert 5).	The gender segregation is significant	
The gender segregation beginning from high school to universities (Expert 5).	The gender segregation beginning from high school to universities	
So their life could not be separate from the what's happening in STEM, STEM major, STEM disciplines or the university. So it's all connected individuals and society together, otherwise how, how we can deal with the whole gender equity issues, right? (Expert 2)	Women's life could not be separate from what's happening in STEM	Social problem
Educational choices of female students, like those of male students, are not at all spontaneous and intimately desired, but, on the contrary, are bound by a sexist imagination that imposes on both (male and female), the routes deemed suitable for the genre to which they belong. (Expert 5)	Educational choices are not at all spontaneous	
This imaginary is continuously nourished by the messages proposed by families, by the mass media, but also by the school itself. (Expert 5)	Educational choices are nourished by the messages from families, mass media, but also the school itself	
It might not be like gender bias but it's gendered practices and the way that are gendered….(Expert 3)	It's gendered practices	Structural problem
Or so all these gendered structures work exactly from the very top of political levels of high education, but also into the learning and teaching practices that we have at our programs. (Expert 3)	From different political level, leaning and teaching in HE	
So even in the study culture, there's also some gender structure in terms of how you kind of get recognized by your peers, who has the right to speak, who can get access to help and who cannot. (Expert 3)	Study culture is gendered	
There's a lot of studies showing that reading applications and knowing putting gender in students' names, which a lot of universities still does, would have effect on the outcome to admission and student evaluations. Even students' evaluation, evaluation of teachers whether they are male, or female or other genders would affect they interact with their outcome assessments. (Expert 3)	Gender influence admission and evaluation	
We are trying to look at how within some of these teaching that's done in different discipline like the teaching and learning practices, how to gender in exclusion mechanisms look like within them. (Expert 3)	Gender forms an exclusion mechanism in teaching and learning	Educational problem
At school there is a big problem regarding the lack of specific training	Specific teacher training in	

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in gender culture for teachers so that they are equipped with the necessary tools to promote gender equality in education and in society in general. (Expert 5)	gender culture can promote gender equality in education and society	
Few variances between biology, physics, computer science and chemistry…it's quite different because that's a more like very math based…if we are looking at like biological science, the story is about different. (Expert 2)	STEM inequality different from different discipline	Contextuali-zed
It might not be the same solution from one university to another	STEM inequality differs from universities	
The proportion of women is different in bachelors, masters, and PhD in mathematics in China	STEM inequality differs from attainment levels	
So I think it differ across universities, across countries, but also across disciplines. (Expert 2) And in the United States, what they try to do a lot of work is in community colleges. (Expert 2) And then the faculty talk about in terms of undergraduate level in China, there are more women like a 60% something like that. (Expert 2)	STEM inequality differs from countries	
Especially by gender and race and many women of color. you should think about like how people perceive women from poor family, women from single mom parents were women who are person of color	STEM inequality different across women with different background	
So it's all connected individuals and society together; life could not be separate from the what's happening in STEM	Women in STEM discipline can't be separated from the society	
It's(women's) very competitive in resume and interview, we often recruit women. Female undergraduates is already a few tenths of a percentage point higher than that of male students. There is no such gender difference in employment and admission. (Expert 1) When she goes on maternity leave, we'll hire a student assistant. It's not that we're doing this because students are discriminated against. We don't think girls are any different from boys at all. (Expert 1) There are also some stereotypes that girls may not be able to go too far in the field of science and engineering. (Expert 1) The stereotype of girls in society needs to change. Don't say that girls must not belong to science and engineering. Don't look at girls with this image thinking view that women's thinking is more emotional. (Expert 1)	No gender bias but gender stereotype	Vague attitude
They just accept that Women are not interested in math. (Expert 2) They do not say women is not good at math. (Expert 2) The people just accepted the fact that, the women just don't like engineering. (Expert 2)	Women are not interested in engineering	

Everything is a very competitive and I do not see like. That's not the future that I want. (Expert 2)		
Every-one of them has a lot of gender bias. (Expert 3) Study culture there's also some gender structure. (Expert 3) And one of the things we found there was it was not that they didn't feel part of the community, but the part of the community they felt the female student was very isolated the part of the community. So, they still have the sense of belonging, but was very isolated part of the program that they were able to and have access to form a sense of belonging within. (Expert 3)	Gender practice	
Sexist division that leads female students to pursue so-called feminine ones (liberal arts). (Expert 5) Sexist division that leads male students to pursue subjects considered masculine. (Expert 5) Gender segregation becomes more pronounced in the transition from high school to university. (Expert 5) The phenomenon emerges in the choice of type of high school and becomes still more evident in the selection of university. (Expert 5)	Gender division	

The first theme is gender segregation, highlighting gender bias in HE results in a gender segregation in STEM. The sub-themes include there is a sexist division through gendering subjects, the gender segregation is significant, the gender segregation beginning from high school to universities.

The theme "there is a sexist division through gendering subjects" illustrates the manifestation and reason of gender segregation. The manifestation of gender segregation is that there is a sexist division in HE，there are more male student in science and technology majors and more female students in liberal arts majors. The reason for gender segregation is gender bias. The gender bias work in a way that provides different kinds of majors with differ gender, when science and technology majors are considered masculine, the liberal arts majors are viewed as feminine ones. The theme "the gender segregation is significant" highlights that the gender inequality in HE is still an unsolved and important problem. The theme "the gender segregation beginning from high school to universities" reminds that the gender segregation in HE is not an isolated problem. Especially in the context of Italy, the formation process of gender segregation is even more different. As the high school has already had specific professions, the gender

segregation in HE is a continuation of the gender segregation in high school, which highlighting that the high school system should also be pay attention when considering the problem of gender segregation. As one expert said that:

There is a sexist division that leads male students to pursue subjects considered masculine (science and technology) and female students to pursue so-called feminine ones (liberal arts). In Italian high school, the gender segregation is already very significant (68.9% of boy students enrolled with a prevalence for the technological sector which sees 81.5% of male students enrolled; furthermore, boys prevail in professional institutes for industry and crafts (77.3%)). In the Italian education system, as the high school has already had specific professions. The gender segregation beginning from high school to universities. (Expert 5)

The second theme is social problem which refers to the reason for gender bias in STEM, implicit gender bias comes from social influence. There are 3 sub-themes recognized concerned the theme "social problem": women's life could not be separate from what's happening in STEM, educational choices are not at all spontaneous, educational choices are nourished by the messages by families, mass media, but also the school itself.

Gender stereotype and on major choice is influenced by the sociocultural norms, through families, media influence, school and so on. Not only the experience in higher education institutions is influence by the society, when students go out of school, the society continues to influence. In this case, the gender bias is come from the society and durably influence by the society. As Information provided by experts:

So if you look at more micro only like what's happening in the in the field or the program, women still may have some good opportunities there but when they close the classroom door and then back to their home and their moms like working in farm or factory never treated very well or these students should work like overnight with a minimum wage because they need to keep up the tuition or whatever right. So, their life could not be separate from the what's

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happening in STEM, STEM major STEM disciplines or the university. So it's all connected individuals and society together, otherwise how, how we can deal with the whole gender equity issues, right? (Expert 2)

Educational choices of female students, like those of male students, are not at all spontaneous and intimately desired, but, on the contrary, are bound by a sexist imagination that imposes on both (male and female), the routes deemed suitable for the genre to which they belong.   This imaginary is continuously nourished by the messages proposed by families, by the mass media, but also by the school itself. (Expert 5)

The third theme is referring to gender inequality in STEM in higher education is a structural problem. As gender inequality is a problem withthin the society, it's embedded in every people's mind, and embedded in every stage in the higher education institution, goes from application, outcome to admission, results of student evaluations, teacher training, student community interactions and all the practices in the higher education, gender is all there playing a role. So, in the higher education system, it needs to focus on the whole process including the administration process and education in universities. As information's provided by experts:

It might not be like gender bias but it's gendered practices and the way that are gendered…. And here gender play a role…But I think in general, gender plays a huge part of also all these invisible and tested learning, teaching and learning practices that we have within higher education then. (Expert 3)

I think it goes from the application. There's a lot of studies showing that reading applications and knowing putting gender in students' names, which a lot of universities still does, would have effect on the outcome to admission and student evaluations. Even students' evaluation, evaluation of teachers whether they are male, or female or other genders would affect they interact with their outcome assessments. There's also lots of research on the assessment

methods that we choose and the gender effects on for example, multiple choice contra all examinations that will interact with gender. (Expert 3)

I just today had this paper published where we looked at student culture at computer science programs whereas there's a minority of women applying for entering computer science. And one of the things we found there was it was not that they didn't feel part of the community, but the part of the community they felt the female student was very isolated the part of the community. So, they still have the sense of belonging, but was very isolated part of the program that they were able to and have access to form a sense of belonging within. So even in the study culture, there's also some gender structure in terms of how you kind of get recognized by your peers, who has the right to speak, who can get access to help and who cannot. (Expert 3)

Or so all these gendered structures work from exactly the very top of political levels of high education, but also into the learning and teaching practices that we have at our programs. (Expert 3)

The fourth theme "educational problem" refers to the fact that, gender embedded in the practice of education through all the stage in education, but at the same time, education have the potential of change the society through education and promote sustainable development of the society. As is recognized in the sub-themes: gender forms an exclusion mechanism in teaching and learning, specific teacher training in gender culture can promote gender equality in education and society. As gender play an important role in the society, but it's important to recognized how gender function in the process of teaching and learning. How gender forms an exclusion mechanism in teaching and learning process. On this basis, can positively function from a pedagogy way. But as highlighted, the basis for education to make a difference, for eliminating gender stereotype influence on the teacher and teacher's teaching process, and decrease the gender inequality impact from the society, could be specific training in gender culture.

Specific training in gender culture for teachers can equipped teacher with necessary tools to promote gender equality in education and through education to make a difference in the society. As the expert said:

At school there is a big problem regarding the lack of specific training in gender culture for teachers so that they are equipped with the necessary tools to promote gender equality in education and in society in general. (Expert 5)

We are trying to look at how within some of these teaching that's done in different discipline like the teaching and learning practices, how to gender in an exclusion mechanisms look like within them. (Expert 3)

The fifth theme "contextualized" refers to the facts that the problem concerned gender in STEM in higher education institution is different in different context. There is a lot of level when it's talk about gender equality in STEM, for example, disciplines, countries, universities, attainment levels, women with different background, the situation and difficulty we faced is different.
For the gender inequality of the same discipline in different country, the situation is different. For the policies to increase female in STEM in different country, the way and effect changed depending on the country context especially the different education system. In the same country, the situation and problem of different discipline is also different. When gender equality in STEM is stalk about, it should be put in different context. When the action is taken, it shouldn't be the same but take different context into consideration. As it's explained by experts:

I think there is few variances between biology and physics and computer science and chemistry. So, we are trying to look at how within some of these teaching that's done in like the teaching and learning practices, how to gender in exclusion mechanisms look like within them. And we are in the very beginning of the process, but it's very different what we see across those different contexts. So, one thing I think is important is to. Look at the concrete context and there it might

not be the same solution from one university to another but and then but not either from one disciplinary practice to another. (Expert 3)

"so gender equity issues in subdisciplines within STEM fields, it's quite different if we study engineering and computer science like statistics or economics together because that's a more like very math based; and whenever we talk about gender equity issues in that field, math is the core part that we are really distinguished whether they have a math ability, math skill sets, math aptitude or things about math; but if we are looking at actually like biological science, the story is about different.(Expert 2)

And that's different here. So, physics is going down and math is… So I think it across universities, across cross countries, but also across disciplines and there's we need to remember that there is differences and different challenges and different structures that we need to work on. (Expert 3)

And in the United States, what they try to do a lot of work is in community colleges because tuition is much cheaper or almost free, and students can take more remedial or foundation of courses in community colleges and then come to university. So they can save money at least and then continue to study engineering. The problem is that many of Hispanic women students do not choose math courses at the Community College. (Expert 2)

Concerned women with different context, the gender equality issue is becoming so different. Especially these women who is with vulnerable background, like poor, immigrant, race… The problem and difficulty part for solving the issue is become different. As the experts suggested:

I said being a woman is not happening like vacuum without any contacts because we are women.But also, for example, me like I'm Asian or I never thought about Asian like when I live in Korea.But like being in US, I'm think..(Expert 2)

Especially by gender and race and many women of color, black women or Hispanic women do not tend to choose that math courses that is the required for going to engineering. (Expert 2)

So gender bias does not really only talking about how people perceive a women, but you should think about like how people perceive women from poor family, women from single mom parents were women who are person of color, women who have immigrant histories, STEM fields often assume that as a very male white middle class or high income middle income class background. (Expert 2)

Concerned the situation in different attainment level, like bachelors, masters and PhD, for the associate professor and the professor, the landscapes is changing. As the expert putting example of mathematics in China and professor and associate professor in biology, the situation is different:

They talk about mathematics department, so I know more about engineering, but I didn't know mathematics very well. And then the faculty talk about in terms of undergraduate level in china, there are more women like a 60% something like that. There are more women who study mathematics as an undergraduate degree. However, when they look at master's and PhD, the proportion of women goes down like a 10%. So the problem is quite different. (Expert 2)

when you look up undergraduate students in biology, actually there are more women, if you look at like Graduate School and academia, the faculty demographics changed; there are many assistant professors among women in biology, but if you look up like associate and the full professors, the academic environment, university studying doesn't really work for women faculty. (Expert 2)

As it's suggested, the situation of women underrepresentation or un-fitting in STEM shouldn't

be separated from that in the society. If the measures only focused on the situation in the STEM disciplines, women will still be influenced when she is not in the STEM discipline. With the social problem as the background, the problem of STEM women should also be put outside the STEM discipline. As is suggested by experts:

...being a woman is not existing without context or discipline would be same too. (Expert 2)

So if you look at more micro only like what's happening in the in the field or the program, women still may have some good opportunities there but when they close the classroom door and then back to their home and their moms like working in farm or factory never treated very well or these students should work like overnight with a minimum wage because they need to keep up the tuition or whatever right. So their life could not be separate from the what's happening in STEM, STEM major STEM disciplines or the university. So it's all connected individuals and society together, otherwise how, how we can deal with the whole gender equity issues, right? (Expert 2)

The sixth theme is vague attitudes, which means when talking about the implicit gender bias in STEM in higher education, the attitudes of experts are vague in defined it as a gender bias. With the answers from 4 experts, their answers are different. One express that she doesn't think there is any gender bias, one say the cognition in STEM field now is that they believe women just not interested in engineering, one says that it's not gender bias but gender practice that exist in higher education system, one defined the situation in STEM field as gender division.

With the expert expressed supported there is no gender discrimination in universities, she believed that the recruitment procedures in universities is gender equality, and as the girls' performance is always good, there are more girls working in the university now. Secondly, as she knows in her university, the number of females is little bit more than males in total. But it can be noticed that, when she talked about giving suggestions, she suggested that the stereotype about girls is not good at science and engineering and girls think more emotional should be change. And she mentioned several times about "we don't that girls are not weaker than boys".

On this basis, she doesn't define gender stereotype of women not good at STEM as gender bias not matter implicit or explicit. As expert mentioned:

For example, in the recruitment of employees, because I am also the director of the human resource department, when we recruit, except for some, for example, we need to be on duty at night, we need to patrol, and we need to be male in terms of campus security, other things will not be said, we must recruit men or women, women will be weaker. On the contrary, girls now have good study performance, it's very competitive in resume and interview, we often recruit women; of course, so as a result, especially in the administration, the administration, we have more women in our school now. (Expert 1)

As far as our university is concerned, it seems that the proportion of female undergraduates is already a few tenths of a percentage point higher than that of male students, so there is no such gender difference in employment and admission. (Expert 1)

Now that there are more female administrators in our school, we sometimes worry about what will happen if these girls have children later, with one child, two children, but we have no choice but to say that when she goes on maternity leave, we'll hire a student assistant or something to cover the maternity leave. (Expert 1)

It's not that we're doing this because students are discriminated against. (Expert 1)

There are also some stereotypes that girls may not be able to go too far in the field of science and engineering, they may only be suitable for liberal arts and secretarial class, the stereotype of girls in society needs to change · don't say that girls must not belong to science and engineering, don't look at girls with this image thinking view that women's thinking is more emotional. (Expert 1)
We don't think girls are any different from boys at all. (Expert 1)

One expert said that as she observed, the people just accepted the fact that the women just don't like engineering. She also talked about what she observes because female don't like the work of STEM and doesn't witness good role model as her, so she doesn't like to work in STEM. As expert expressed:

However, in terms of like assumption or perception even I do not want to say that as an already stereotype but just like very day daily basis, a very regular perception especially in engineering that all STEM field. faculty, parents or even students have some thoughts about women are not interested in math". (Expert 2)

The people just accepted the fact that, the women just don't like engineering. (Expert 2)

They observe that the women post doc spend like six or seven years at the lab do not have any personal time or do not have a lot of time with the family and just really the only one working at lab and see women may not feel like, oh that's not the future that I want. (Expert 2)

Everything is a very competitive and I do not see like the women, do not see anybody like her or faculty do not really understand what's going on to me or my life or my interests or how I learn and all things. (Expert 2)

Of course, like they do not say women is not good at math (Expert 2).

One expert believed that there is a lot of gender bias in every layer in higher education institution. Practice related to gender in the student communities in higher education institution, but it can't be defined as gender bias. As the expert mentioned:

I think actually every-one of them (higher education institution activities) has a lot of gender

bias in it. And as I'm sure you already know. I think it goes from the application. (Expert 3)

A student culture at computer science programs whereas there's a minority of women applying for entering computer science. And one of the things we found there was it was not that they didn't feel part of the community, but the part of the community they felt the female student was very isolated the part of the community. So, they still have the sense of belonging, but was very isolated part of the program that they were able to and have access to form a sense of belonging within. So even in the study culture, there's also some gender structure in terms of how you kind of get recognized by your peers, who has the right to speak, who can get access to help and who cannot. It might not be like gender bias but it's gendered practices and the way that are gendered. (Expert 3)

One expert defined the form of gender bias in higher education as gender division and think that the gender division begin from high school. As the expert suggested:

In the Italian education system, there is a sexist division that leads male students to pursue subjects considered masculine (science and technology) and female students to pursue so-called feminine ones (liberal arts). (Expert 5)

In Italy, the phenomenon emerges in the choice of type of high school and becomes still more evident in the selection of university courses. (Expert 5)

Gender segregation becomes more pronounced in the transition from high school to university. (Expert 5)

4.2 Implementation: Policies Practice on Gender Equality in Higher Education

Concerned the policies mentioned by expert for promoting gender equality in STEM in higher

education, there are three themes being recognized, most are not university policies, negativity of policies, various initiatives.

Table 29. Theme and Sub-theme of Policies Practice from Expert Individual Perspective

THEME	SUB-THEMES	NOTE
Most are not university initiative policies	Foundation takes the initiative to support women	The foundation has been very concerned about the cultivation of women growth (Expert 1).
		The foundation believe it's needed to provide more help to girls (Expert 1).
		The foundation suggested a way to take turns to stay, so that more girls could benefit (Expert 1).
		Not to say that this program is because the girl is lacking anything (Expert 1).
		Girls in the employment environment, there will be some gender discrimination especially now girls can have more children (Expert 1).
		Because there are stereotypes that girls may not be able to go too far in science and engineering fields (Expert 1).
		Because there are stereotypes that girls may only fit into this liberal arts discipline (Expert 1).
	Research funding support measures	The big funds have been more aware of gender in in their strategies (Expert 3).
		Institution wants to apply for funding from Horizon Europe program, gender equality plan is a necessary part of it (Expert 4).
		I think the push is coming from industry, economic discourses, and EU policy (Expert 3).
	Individual initiative to implement measures	I have tried to say that other universities they have a diversity panel (Expert 3).
		It is very important for me that everyone has a voice (Expert 3).
		They were doing their small department gender project (Expert 3).
	Funding of country	We received the grant from the National Science Foundation …for the project conducted in the 2-year community college (Expert 2).
Negativity of policies	Lack of university policies	I don't know of any measures actually at the science faculty at my university (Expert 3).
		It has been difficult to move those ideas off that we do not have a problem (Expert 3).
		There is no need to set up a policy specifically for one group (Expert 1).
	Lack of support from HE members	So one obstacle was on the institutional level because the topic didn't seem to be that important or beneficial to institution (Expert 4).
		The other the other obstacle is related also to society because the gender equality isn't very popular (Expert 4).
		So I would say the main obstacle was the resistance to gender equality (Expert 4).
	Some part didn't change through	I see very similar problems after 16 years (Expert 2).
		It's happening all the time still (Expert 2).

	policies	The percentage of women is 20% for three decades across the world (Expert 2).
	Policy should be implemented indirectly	We shouldn't say it directly, what do you want (Expert 1).
		We need to use the form that students like to educate her imperceptibly (Expert 1).
		This was I think very clever way how to avoid their(top management team people) excuses(Expert 4).
Various initiatives	Building female community	Professional association where women and people of color, like rule as a mentor and advisor for the undergrad students (Expert 2).
		The master or doctor can give some guidance to the undergraduate (Expert 1).
		We will ask the teacher to give them some guidance (Expert 1).
		Big sisters help they from the psychological career planning, as well as the value of life, to give them some guidance (Expert 1).
	Providing financial support	We will support him to pay for his travel expenses, accommodation, travel, and conference expenses (Expert 1).
		We will support to buy a software for research (Expert 1).
	Conducting inter-discipline education	To provide girls some cross-learning courses and STEM study support to female in STEM in university (Expert 1).
		Train her, such as her speech ability and her communication ability (Expert 1).
		We invite these pastry chefs outside to teach students how to make cakes (Expert 1).
	Academic Support	When chat GPT launch, we immediately invite experts to talk to them (Expert 1).
		We will ask the teacher to give them some guidance (Expert 1).
		Gender equality needs a long process, but for us girls, we need to be good enough. So as a school, we must encourage girls to be better (Expert 1).
	Support based on need	We do a questionnaire when the STEAM students come in, and we ask them, what do you want help with, and then we look at what we can do so that we can really help them (Expert 1).
		We need to let the students design some small drama, or to use music to treat his psychology and so on to be able to express himself, and then give him some guidance (expert 1).
		If students pursue further studies, such as going abroad to study for a master's degree and a doctorate, how to write scientific papers will be guided (Expert 1).
		We have a teacher who has a fixed time in one semester to train them, including English pronunciation and intonation, the ability to take the IELTS exam and so on, so that they can smoothly go to further study (Expert 1).
	Lay a good STEM learning foundation	This focused on STEM selection or compensation for math foundation maybe should start early. (Expert 2).
		Have more Math courses in cheap community university and apply to go to university to study engineering (Expert 2)
	Redesign curriculum	Try to redesign curriculum that would be more interesting for Latina's women (Expert 2).
	Provide Female Role model	We made for example photo, exhibition, photo and of female or female scientists (Expert 4).

| | | Should try to speak about some examples like mentioning scientists that also female scientists (Expert 4). |
| | | They selected a 10 or12 faculty who can be role models for students, particularly Hispanic students is talked about (Expert 2). |

From experts' interviews, it was observed that a significant portion of policies are not proactively initiated policies by the universities themselves or conducted in universities. some initiatives are conducted by the suggestions of foundation and depending on the special fund from the foundation, some initiatives are conducted on expert's willingness or individual group's initiative change, some initiatives are conducted because gender equality actions it's demanded by funding foundations as an conditions for getting funds.

For the measures conducted by suggestions of the foundation, the foundation suggested the activation of this project on the willingness of promoting the development of female students.

The implementation of the STEAM project addresses gender discrimination encountered by girls in employment and stereotypes of women in society. In the interview, it was mentioned that because women are subject to gender discrimination in the employment environment, and after the introduction of the three-child policy, women's birth restrictions are relaxed, women may suffer more discrimination in employment, and more help is needed for women's development. In addition, the influence of social stereotypes is also serious, on the one hand, women are better suited to study liberal arts and do secretarial work, on the other hand, women face a glass ceiling in science and engineering fields, it is difficult to achieve high academic achievements, driven by these motivations.

As the expert described:

Because they (the foundation) have been very concerned about the cultivation of women growth. So, they believe it's needed to provide more help to girls. So, they made special donations, and now this college is operated with the original site and special donations. (Expert 1)

Then, when it was established, it also told us that it was a way to take turns to stay, so that more girls could benefit. (Expert 1)

We introduce such a program, not to say that this program is because the girl is lacking anything, we give her the original intention is not like this. (Expert 1)

Girls in this employment environment, there will be some gender discrimination. Especially now girls can have more children, have two children, three children. Then there are the stereotypes that girls may not be able to go too far in science and engineering fields, that they may only fit into this liberal arts discipline and doing the secretarial work. (Expert 1)

Although the STEAM project was implemented within university and targeted at female students in STEM of University, it was supported by the Foundation outside the university for the action and implementation of the entire project, and wasn't a measure taken by the university to take the initiative or call for policies. (Expert 1)

Some measures are come from the individual, who try to introduce individual initiative to implement measures. As the one expert said, she tries to build inclusive environment in her research group and make everyone's voice heard. What's more, some people in geography discipline that try to make a change in the group and work so well. As the expert described:

I have tried to say that other universities they have a diversity panel, but we don't have that at my university still.   But I think one of the things that I'm very aware about is to when we have meetings in a research group, it is very important for me that everyone has a voice, it goes from PhD student to associate professor to professor level so that everyone can take turn in deciding what they want to discuss. (Expert 3)

I heard, someone from my university that was a couple of actually female researchers from the department of geography and they were looking at they were doing their all small department gender project and they found out that weight women earned less than men but now they have

actually made change. (Expert 3)

The theme research funding support measures refer to some measures mentioned by experts are the measures related to the research funding. One is also belonged to the expert's individual initiative to implement measures, as she tried to promote gender as a standard for applying for fundings and succeed. One is the gender equality plan asked by the EU as a standard for funding. So, these gender measures are taken because of the demand of fundings which is outside of the universities. As is suggested by experts:

I think the first course in diversity is currently in construction and that is because the EU, when applying for EU funding, you need a course in gender equity in terms of applying for these funding. So I think then the universe, yeah, so then the university now begin having some of these courses. But I think the push is coming from industry, economic discourses and EU policy rather than like, yeah, a matter of university wanting to change practices by themselves. (Expert 3)

Another thing I've been trying to do, and I think been successful in is to work with the Funding Agency in having equity as a focus and I think that I've succeeded like the past years, the funding, the big funds have been more aware of gender in in their strategies. Why We also have gained quite substantial research funding in this field of research. But that that is from, you can say, outside university practices, but it affects the research that we can do now within university that we can get external funding, but it's not easy. (Expert 3)

OK then in relation to gender, gender equality, basically our gender equality plan has been approved at the end of 2021 and so this was already in the period when horizon your program has its requirement on gender equality plan. It means when one institution and wants to apply for funding from Horizon Europe program. Gender equality plan is a necessary part of it. It's simply a requirement. So, we had original plan gender equality plan and we had to adapt it on

the requirements of Horizon Europe. (Expert 4)

One measure concerned is funding by country (the USA) for increasing transfer STEM women to universities. It aims at the community university, try to help women in poor family to go to universities to learn STEM. It's an out of universities initiatives which try to help to get more female student form the poor situation. And this is also the case doesn't happen as universities try to retain student or try to improve the numbers. As expert described:

So the whole research grant was about how we can increase Hispanic women students in engineering and of course the problem is that they are not really prepared in terms of math. So when they come to the university, if they are interested in engineering majors, they take a course and then they fail.
So they have to take a more remedial courses to catch up everything. It's not the problem of the individuals, more problem is that they usually do not attend high school which offer certain level of math courses. So they often do not have the opportunities to take advanced math courses like other students, like other Asian or white students. So they try to make up these courses at the university. The problem is that that means like they need to take more credits while they are in college, so they cannot finish engineering within five years or four years. So rather than choosing engineering major, they are choosing something else which can take only like 3 or 4 years and they can graduate and they can get a job, right. But that's usually what's happening with Hispanic women and men students. And in the United States, what they try to do a lot of work is in community colleges because tuition is much cheaper or almost free, and students can take more remedial or foundation of courses in community colleges and then come to university. (Expert 2)

Some measures taken in universities depending on funding of country. As is described by an expert:

I felt observed actually every day like I've been look like because we received the grant from the National Science Foundation there was a for supporting Hispanic women students because our institution is a Hispanic serving institution. We got that grant work. (Expert 2)

The second theme is negativity of policies, this means from what experts described the policies in universities showed in a negative way. On the one hand, there is lack of policies in universities for promoting gender equality. And it's not easy to push the process of policies in universities. The most useful methods for pushing the university to take active action concerned gender equality is involved gender as the standard for applying for fundings. On the other hand, when universities policies conducted, it seems difficult to get support from the other or more people in the university to act actively. What's more, it's very difficult to see effects of the policies in higher education institutions that try to promote gender equality. Especially in some part in the universities like engineering discipline, it doesn't change through the expert who is researcher in this field and observe this for more than 10 years. And it's strongly suggested that when is policies is not about input and output, the gender segregation in STEM is a problem which is difficult to be change, a long term plan is needed.

About the theme lack of university policies, it's described by experts being interviewed, it's difficult to promote some policies concerned gender equality in universities. Moreover, from the process of collecting expert interview data, the author found that, most of the experts didn't think she can answer questions about the policies that implemented in the universities. With the data successfully collected, there is two experts insisted that she didn't know any policies implemented in the universities, one expert didn't answer, and one expert said her universities began to have gender equality initiative is because the requirement of funding.

The theme lack of university policies is describing the situation that there is lack of university policies which showed the situation that the policy in universities is not the issue that attracted the attention from the university level. With the lack of policy, it shows a negative viewpoint of the policies on gender equality policies in STEM. From what experts described:

I don't know of any measures at the science faculty at my university. (Expert 3)

But I think normally you would think of Scandinavian countries as very aware of gender equality, but here in Denmark it's not the case. The case is that we think we already fixed that. So all the tacit in an exclusion mechanisms are kind of very tacitly embedded within our programs. So I think it slowly begins to change but it has been really difficult to put gender on the agenda within our university because we think like everyone has a higher education, is free of fees, we don't have any fees, everyone can apply, so that haven't stole the idea that it is accessible to everyone. So it has been difficult to move those ideas off that we do not have a problem. (Expert 3)

No, as far as I know, because as I said, we don't think girls are any different from guys. Anything a guy can do, a girl can do, and vice versa. So, there is no need to set up a policy specifically for one group. (Expert 1)

As an expert who work in STEM university, expressed the difficult to implement gender equality plan in university. As in STEM universities, the people don't view gender equality as an important problem here and with the influence from the society that also think the problems is not important. The Lack of support from higher education members and lack of attention from the society. As it's expressed by the expert:

So, it was quite difficult to approach in the quality plan here because. Because really in our perception a topic this this kind of soft topics and the gender equality is in my opinion one of them is quite difficult to be persuaded or somehow promoted at STEM university, because you know, some people, they are just focused on data. So, for them it's really very complicated to communicate, to communicate such a topic. So I would say the main obstacle was the resistance to gender equality. (Expert 4)

So, one obstacle was on the institutional level because the topic didn't seem to be that important or beneficial to institution. (Expert 4)

And this resistance, it's not only on the institutional level, but there's also resistance on the national level. We are here in Slovakia. And gender equality, I would say in a very polite way. Gender equality doesn't have the very best image here. This topic is very often abused in political fights among the actually by the political parties. So, the environment in society was also not helpful. and the other obstacle is related also to society because the gender equality isn't very popular, isn't very popular topic here in in Slovakia. (Expert 4)

And therefore, we have decided to do this in a very like natural way and how our employees are informed teachers and researchers about the gender aspects. (Expert 4)

What's more, in the theme "some part didn't change through policies", an expert who work as a researcher in the fields on diversity in engineering fields expressed a negative idea about the effects of the measures in the universities on promoting gender equality. What she has been viewed is that, although the polices showed a positive prospect of gender equality in STEM, but the action is not as good as researcher and people who suggested the policy think. Some part didn 't change through implementing the policies. There are all kinds of policies being implemented in STEM fields on gender equality, but it ends up in a negative viewpoint of the policy. As the expert presented:

So, I've been observing or search of software system all the time. But I also want to mention that like that's I've been observed that 10 years ago too. I started studying about this 2007 or 2008 through my doctoral like graduate assistantship for engineering education. We talk about same thing internship, cooperative education, undergraduate research. We talk about all sorts of like support systems and programs for women and people of color. So, like even like the after 16 years, I see very similar problems in terms of gender and racial equity still in that field.

(Expert 2)

So engineering faculty try to redesign curriculum that would be more interesting for Latinas women or they selected a 10/12 faculty who can be role models for students, particularly Hispanic students. (Expert 2)

Measures university to support female students, Like, not sure it was about measures, but I've been observing a lot of support systems for women students in general at university, but also specifically in STEM field. (Expert 2)

Some parts could be changed, but other parts never changed. Still, the percentage of women is 20% for three decades across the world. (Expert 2)

The numbers of women have not been increased in undergraduate, in engineering disciplines it's really hard to increase the representation. It's always about 20%. (Expert 2)

It's happening all the time still, so I would say I've been seeing a lot of supports, but I've been seeing a lot of oppression and discrimination and bias and stereotype microaggression all the time in that field too. (Expert 2)

Concerned the implementation of the measures to promote gender equality, some experts expressed that the idea to make sure the policy works in a good way to avoid resistance is that the policy should be implemented indirectly. One expert shares the experience about conducting gender sensitive training courses to top management team. Top management team, who are in the STEM university and not interested in gender equality, will probably reject to take the courses with excuse. So, the idea to giving the courses is embedded the courses in the regular meeting. So, when they didn't realize that it's a course, they have already done it. In this case, the expert is talking about the policies shouldn't be conducted in a directly way.

When another expert talking about how to implement the initiatives, she also suggested that it should be done in a way female student like, and it's not a good idea to conduct the training on eliminate gender equality directly like required the student to do something. As is expressed by experts:

We need to use the form that students like to educate her imperceptibly in the process of carrying out this activity. We shouldn't say it directly, what do you want, such a statement is now very offensive to students. So, we have to ask the student to design some little plays, to let the student express himself, and then say the words that he is afraid to say, and then we give him some guidance, this kind of activity. (Expert 1)

And perhaps what I would like to share about the trainings, what we were able to achieve, and this is we consider we consider this as a big success that our top management has been trained. And this is something very extraordinary because people from top management, they are usually pretty busy and people from top management from Step for STAM University, they are not just busy but usually not that much into the topic, but how we were able to do it. They have they have a regular meeting and this meeting it's called meeting of the College of director, and we incorporated this training of course in it. It was not that long as usual but it we incorporated this training into the meeting of the top management team. (Expert 4)

You know so this was I think very clever way how to avoid they excuses in the way we I do not have time, you know, because they simply they had to be there. (Expert 4)

The third theme on policies implemented is various initiatives which aimed at presenting the initiatives that have been implemented in higher education concerned STEM fields. There are different initiatives being talked about, for example, building female community,

Concerned about the theme building female community, it's talk about try to build a community that minority people can find kind of belongings inside, where is easy for them to seize help, find a role model and build an inclusion feeling. In one of the initiatives, the female college in the university conducted the strategy is by housing STEM women together, including undergraduate, master's and doctoral students from all colleges, it creates a gender inclusive community of women, exposing women to more STEM women, and making it easier for a woman to seize help, find her role model and sense of belonging in a place that is not completely surrounded by masculinity. And there is also programmed that female student in universities

help the female from lower academic attainment level. Through such projects, college girls give guidance and help to girls studying in vocational secondary schools and technical secondary schools through psychological, vocational exchanges and planning suggestions, which is the power of female role models for little sisters and may play a role in promoting girls' potential. And also, some associations where can provide mentor and advisor for the minorities and help them build a sense of self-concept and belongings in the fields. As is mentioned by experts:

At the beginning of the project, it was planned to take turns to live in, so that more girls can benefit from it. However, the effect of taking turns in the way of living only three days and five days, at most half a month to a month, was not obvious, so the expert 1 proposed to let girls fully participate in the project by living for one year (Expert 1).

But if you look at like association for Hispanic engineers, like something for black engineers, there are a lot of like a professional association. So women and people of color, like rule as a mentor and advisor for the undergrad students. So they have some matching system or they have a lot of events, so many things that happen outside of the campus too. (Expert 2)

Since there are undergraduates, master's students, and doctoral students living together, the communication between them will also have some inspiration. For example, we will let the students do some projects by themselves, and talk about some of their research plans, and then the students will discuss, for example, the master or doctor can give some guidance to the undergraduate, or we will ask the teacher to give them some guidance. (Expert 1)

Secondary school girls, they may be, secondary school, cannot take the high school entrance examination, cannot take the college entrance examination, they may psychologically ah, all aspects will have some inferiority, that our big sister help they from the psychological career planning, as well as the value of life, to give them some guidance. (Expert 1)

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Undergraduate women help technical secondary school women, its name is Big Sister Program, Chinese means big hand holding small hand, accompanied by her growth, is our college girls and girls studying vocational high school formed a pair, exchange, and guidance. College girls are a big hand, is a "Big Sister", and then, to take the vocational middle school and secondary school girls "Younger Sisters", in turn, can provide opportunities for older sisters to educate and inspire, expanding the scope of inclusive communities for women who support each other. (Expert 1)

A good way to help women in STEM is providing financial support. On the one hand, the financial support can motivate the female student and with financial support. For example in policy 8 of Italy，it suggested to establish scholarships specifically for female graduate students and postdocs in STEM fields and award research projects based on merit. And in policy 4 in China, it's suggested to support institutions of higher education and research institutes in setting up scholarships for outstanding female students majoring in science and technology. And in the initiatives mentioned by expert, one financial support is about providing funding for academic meeting and academic tool like software. As it's mentioned by an expert:

For example, to participate in some professional meetings across the country, we will support him to pay for his travel expenses, accommodation, travel, and conference expenses; and once there was a doctor who had no money to buy software, Later, after she gave an academic report to the students, we will support you to buy a software and support you from all aspects. (Expert 1)

Inter-discipline education has been viewed as a good way to promote female involved in STEM fields and also males in liberal arts majors. And through inter-discipline education, it's helpful in breaking the gender stereotypes embedded in mind (Manchenko, et al.,2022; Runyan, 2018). The interdisciplinary methods presented by expert 1is not only conducting cross discipline learning but trying to teach the female student skills other than STEM skill to help student

develop her comprehensive potential. As it's suggested by expert:

T*o provide girls some cross-learning courses and STEM study support to female in STEM in university, especially from the perspective of cross-learning courses to provide more special training, is the purpose of STEAM project (Expert 1).*

As for female students in STEM, she may have the ability to express herself, but her oral expression and speech ability are not very good, so we will consciously organize this project, and have some teachers to train her, some workshops, some reports, and this will train her, such as her speech ability and her communication ability. (Expert 1)

About "teaching kitchen", it talks about "on some holidays, especially traditional holidays, we invite these pastry chefs outside to teach students how to make cakes and then send them to their parents" (Expert 1).

As a minority in STEM fields, some initiatives try to provide more academic support for female. As is described by expert. The academic support can be some newly seminar that help female keep up with the technology progress. According to the difficulty female faced in STEM, the guidance from the professor in academic is available and help the students develop in the STEM skills which can help them go further in the academic.

1 gave an example, such as the chatGPT launch, its implications for the future and what we can do to prepare for AI, and we immediately invite experts to talk to them. (Expert 1)

Or we will ask the teacher to give them some guidance, that is to say, we hope that there are two plates, one plate is the improvement of comprehensive quality and ability, on the one hand is his professional aspects, some professional skills, professional interests and hobbies, so that he can go further in professional science and engineering in the future. (Expert 1)

Gender equality needs a long process, but for us girls, we need to be good enough. So as a school, we have to encourage girls to be better. (Expert 1)

As the support for women in STEM need to be taken based on recognizing the need of the female students. There are a lot of ways for recognized the need like collecting data and conducting research to figure out(Estrada et al., 2016). As it's mentioned by expert here, the way is through questionnaire and let students involved in the process to design her own methods. As it's concerned by expert:

We do a questionnaire when the STEAM students come in, and we ask them, what do you want help with, and then we look at what we can do so that we can really help them (expert 1).
We are not rigid to say, what do you want, the student is now very disgusted. So, we need to let the students design some small drama, or to use music to treat his psychology and so on. Let the student be able to express himself, and then say the words that he is afraid to say in his heart, and then we give him some guidance, this kind of activity will be more acceptable (expert 1).

With the under-representation of women in STEM higher education, some measures try to promote more women from before universities, for example, from early age and from the academic stage before universities. The USA programme try to promote girls from community university to university because, the community university have cheap fee for study which can compensate the study gap between the poor and the rich. But it turns out that the girls still didn't choose the science and engineering subject for go to engineering fields in the future when science become more popular. So, the theme "lay a good STEM learning foundation" is recognized. It can be seem positive in effect to conduct more course to lay a solid foundation for girls to study STEM subjects，but as the poor learning background before build a significant barrier for girls to choose engineering even they have the chance to make up in the community university, it's still very hard for them. The policy aims to lay a solid foundation for STEM

majors' study should be advanced as early as possible. As is described by the experts:

This focused on STEM selection or compensation for math foundation maybe should start early and every girl who chooses STEM at each stage deserves attention to avoid leaving at one step. (Expert 2).

About the vulnerability situation of Hispanic women who are come from low-income family and have a poor math education level. With the poor Math foundation, they always cannot finish engineering within five years or four years, so they can't afford to study engineering. Since community college tuition is cheaper, so the project would like to promote women have more Math courses in community university so they can study more Math courses in the cheap community university and apply to go to university to study engineering (Expert 2).

From the data, many of Hispanic women students do not choose math courses at the Community College but often choose free science classes that they can do medical, health, field or biological science in community colleges (Expert 2).

The gender and un-inclusive STEM curriculum have always been criticized as reason for female's under-representation in STEM. Concerned the theme "redesign curriculum", the policies introduced is about redesign curriculum that would be interesting for Latin's women. However, from the experts' point of view, that methods don't work well as planned. Obviously, the problem concerned gender gap in STEM fields is not an independent problem. It's not easy to observe how the effect from one kind of method as it's influenced by multilevel of factors. Curriculum to include female student in STEM is not only a result-oriented action but also action that represent justice like education right and equality, to eliminate the influence of gender role in the society is the basis for female to achieve their full potential.

Engineering faculty try to redesign curriculum that would be more interesting for Latina's

women. (Expert 2)

Providing Female Role model in STEM is always recognized as a reason and way for promoting more women in STEM (Porter & Serra,2020; González-Pérez et al., 2020). There are a lot of ways for providing female role models for female in STEM. As is mentioned in the expert's words, it is including photo exhibition about female and male scientist. Female professor in STEM providing tutoring course. When professor giving courses, it's needed to mention female role in science. As is mentioned by expert:

They selected a 10 or12 faculty who can be role models for students, particularly Hispanic students is talked about. (Expert 2)

For new teachers and it they mention it in the way also how to involve the students male and female, and they are also advised that they should try to speak about some examples like mentioning scientists that also female scientists. The gender sensitive training courses is included in the top management regular meeting so the top management team are already trained. (Expert 4)

But we made for example photo, exhibition, photo and of female or female scientists, and not only scientists, but also people working in university or females working in the university administration. And in this way we simply try to promote their work and to encourage our female students or or researchers at the early career stages, female researchers at early career stages to encourage them to take up research a career or teacher career at our university. (Expert 4)

4.3 Advice for Advancing Gender Equality in STEM in Higher Education

There are 9 themes being recognized as actions for advancing gender equality in STEM in HE: setting diversity officer, holistic methods, work with high school student, teacher gender

sensitive training, providing mentorship, cross-disciplinary education, gender quotes, pay attention to the vulnerable, incorporating gender equality as standard for funding. Table 30 presented the themes and sub-themes recognized and some notes withdraw and summarize from the expert's opinion.

Table 30. Themes on Advice for Action in Gender Equality in STEM from Expert Interview

THEME	SUB-THEMES	NOTE
Setting diversity officer	Diversity officer is needed	Some universities there's like this diversity panel or committee (Expert 3).
		Why don't we have an equity committee or gender could be one part (Expert 3).
		All universities we do not have gender equality officers as these roles (Expert 4).
		It would be really very helpful for us when we would have this gender quality officers at universities like officially (Expert 4).
	On department level	Having diversity panel in the departmental level (Expert 3).
		It can be both like on a general level and a department level (Expert 3).
		For me it's very important to look at the very concrete cultural practices within each of these disciplines (Expert 3).
	Monitoring data and implementing policies	Having diversity panel to look through evaluation practice, hiring practices, teaching practices (Expert 3).
		Having someone critically engaging with department and faculty and university practices would be a great start (Expert 3).
Holistic methods	STEM can't be separated from the society	So, their life could not be separate from the what's happening in STEM (Expert 2).
	Involving all society groups of interest	Life could not be separate from what's happening in STEM, STEM major STEM disciplines or the university. It's all connected individuals and society together (Expert 2).
Work with high school student	STEM activities to improve interest and knowledge	Invite girls into the university (Expert 4).
		Try to show them examples without programming when they think engineering is all about programming and boring (Expert 4).
		Can be very interesting also for girls. (Expert 4).
Teacher gender sensitive training	Mandatory teacher training	Need to take a gender course in equity or gender equity, or equity in general (Expert 3).
		University made some of these teacher training course mandatories in the beginning (Expert 3).
Providing mentorship	Mentorship on comprehensive	STEM study support (we ask teachers to give them some guide, we will support his professional skills, professional interests, and hobbies, in the

	development	future can go further in professional science and engineering) (Expert 1).
		Tutor for confident (Including strength-type activities, which we have organized to run the group exercised to improve their strength and ability, and then we took them to ski, go karting, and go cross-country.) (Expert 1).
		Female role model (inviting experts and scholars abroad, or some prominent women, to give them some lectures)
		Tutor between students (Providing some opportunities, some stage for students to come and present their research and project, to talk to each other, to inspire each other and so on) (Expert 1).
		Support for language leaning (how to take the IELTS exam, then we have a teacher who has a fixed time in one semester to train them, including English pronunciation and intonation) (Expert 1).
		Support for thesis (if students pursue further studies how to write scientific papers will be trained) (Expert 1).
		Broaden horizon (we visited what DJI company, BGI Company these big enterprises in Shenzhen, also visited some universities, such as Tsinghua University, Peking University, Wuhan University and so on) (Expert 1).
		Female advantages (Women have their own gender advantages; we do not pursue gender equality that everyone become neutral without gender difference) (Expert 1).
	Mentorship should be faculty evaluation standard	Time spent by professors on guidance should be included in the reward criteria (Expert 2).
		Rewarding in faculty assessment (Expert 2).
	Limited role of individual mentorship	Female is not the problem (Expert 3).
		Fix the system (Expert 3).
	Mentorship should follow the need	Our aim was to have at least 50% of all the mentees to be females (Expert 4).
		As everyone has its own aim for the future (somebody wants to become a professor, somebody perhaps wants to leave university and to go into some other institution, or even to work in a private company), students will choose their own mentors (Expert 4).
	Guidance for eliminating gender stereotype	Recommend professional guidance to pay attention to the gender stereotypes in HE and targeting boys. (Expert 5)
		We should add compulsory training in gender culture for teachers (Expert 5).
Cross-disciplinary education	Establish multidisciplinary platforms and projects	Students from different discipline can communicate in public LABS, entrepreneurship, and innovation centers (Expert 1).
		Establish a platform, and according to this platform, this center will carry out some personnel training work (Expert 1).
	Teacher cross discipline	There should be some platforms for teachers to cross-discipline and bring students to cross-discipline (Expert 1).
	Full credit system	It's a required course for English majors, but it's an optional course for

		computer majors (Expert 1).
		Calculate by credits, and students from different disciplines can study in the same class(Expert 1).
	Cross-desipline dormitory	When a student goes back to dormitory, there are students of different grades and majors (Expert 1).
Gender quotes	The situation is complicated	Equity issues usually do will not be fixed in couple of days (Expert 3).
		Will not change by itself (Expert 3).
		If it is stipulated that at least one vice principal must be female in the upper power class of a university, then there may be only one (Expert 1).
		Man, always choose man. this is difficult to change the consciousness (Expert 1).
	Can be tried	Quotes could be one way to try that out for a couple of years (Expert 3).
		But now in the process of gender equality, when you are fully equal, not use it anymore (Expert 1).
Pay attention to the vulnerable	STEM fields are excluded	STEM fields often assume that as a very male white middle class or high-income middle class (Expert 2).
		You should think about like how people perceive women from poor family, women from single mom parents，women who are person of color, women who have immigrant histories (Expert 2).
	The situation of vulnerable group is different	They have to think of like more micro, macro or like broadly and narrowly in many different parts of it (Expert 2).
Incorporating gender equality as standard for funding	Implementing Gender equality initiatives need funding	All the institutions which are doing some general quality works are able to apply for grants for national grants in UK (Expert 4). Because with money we start everything (Expert 4).
	Gender equality plan as a standard for funding is useful for promoting gender equality	It's always a problem for university to find a budget (Expert 4). Progress the gender equality plan like our university began it's a big progress (Expert 4). Funding game change make universities really motivated (Expert 4). HR Excellence Award for researchers, within this you also have to do some diversity or equality work, as plan for gender equality budget. (Expert 4).
	Gender equality measures as requirements of the national funding	Requirements on gender equality measures as standard for national funding is useful (Expert 4).

Diversity officer is the people in charge of the issue of gender equality in HE institution. As is suggested by experts, the diversity officer is needed in conducting the gender equality issue in STEM. But until now, there is a lack of diversity office in the higher education institution,

without a diversity officer, the process of gender equality is not function.

As general policies fail to target the difficulty in every department to make a change according to the need and progress of every discipline. Through description of expert 3, "So the diversity panel can work as structure for action and monitoring".

Being aware and reflective of our practices and changing them might help, so having diversity panel in the departmental level to look through evaluation practice, hiring practices, teaching practices, you know all the layers that you began with in your first questions. I think having someone critically engaging with department and faculty and university practices would be a great start. (Expert 3)

It can be both like on a general level and a department level. But at least acknowledging that we know that there's biases and we know there's inequalities at stake, and this is something that we might never erase. (Expert 3)

Like having an internal structure for considering that and doing some recommendation. I mean currently we have a sustainability committee and now at our department we only have vegetarian food when we have courses and department seminars and so forth. So why don't we have an equity committee or gender could be one part, but also international scholars, ethnic, you know, whatever diversity parameters. But having that critical voice coming from within, I think could be a quite important step to take and I know some universities have that with various in various formats. But currently now not having that we just closed these reflections and voices that never will be heard. But we know, you know there will be people working on them, but but having some structured way of doing that I think could be a change from within. (Expert 3)

I think there is one thing you should know, and this is that at all universities we do not have gender equality officers as these roles are at the universities of Western Europe，we do not have these functions Yet. It's a problem of course, because then when you do this gender quality work,

you can do it like within different types of projects. But still, it would be really very helpful for us when we would have this gender quality officers at universities like officially. But the reason why we do not have this, I suppose you have heard already about a tennis when in in UK. (Expert 4)

So first of all, to establish a role of a contact person on gender equality at our Ministry of Education and also then to cooperate with the funding agencies and they should involve some gender equality measures like we like mandatory, mandatory. Mandatory actions or requirements of the national funding, and this would be of course. This would be of course a suitable not only for Stanfield, but generally for research and the university education. (Expert 4)

They must think of like more micro, macro or like broadly and narrowly in many different parts of it and then implement that policy otherwise it will not work. Otherwise, it was just a fixing like some parts of it. But not the whole(Expert 2）.

It's very important that high education do not only formulate very abstract policy level documents, but that these are translated differently into different practices", "for me it's very important to look at the very concrete cultural practices within each of these disciplines (expert 3).

Holistic methods are recommended as the gender in STEM is embedded in the society and can't separate from the society. As is mentioned by the expert:

So if you look at more micro only like what's happening in the in the field or the program, women still may have some good opportunities there but when they close the classroom door and then back to their home and their moms like working in farm or factory never treated very well or these students should work like overnight with a minimum wage because they need to

keep up the tuition or whatever right. (Expert 2)

So their life could not be separate from what's happening in STEM, STEM major STEM disciplines or the university. It's all connected individuals and society together, otherwise how, how we can deal with the whole gender equity issues, right? So, some of your questions I see very positive part of it it's been evolving, it's, it's happening but some other parts are like just the same. I still have a lot of concerns about gender equity. (Expert 2)

Including teacher gender sensitive training in the begging can help teacher learn gender knowledge and use it in the teacher process, which is a way to change the situation according to expert explained:

I came to think of now is that at my university all teachers, they need to take a teacher training course. Like everyone teaching at university, they need to complete a teaching trainer program; in the beginning there was lots of resistance, but now this is something that everyone just has to do; we could also have like you need to comply if you have people as a research group leader under you, you need to take a gender course in equity or gender equity or equity in general, so, if the university made some of these things mandatory in the beginning, it might be a lot of resistance, but eventually having everyone completing that could also make changes.(Expert 3)

As the gender inequality in STEM is not only an issue happened in higher education but begin from the higher school period. To improve the participation of STEM, need to work from before higher education.   As one expert suggested, the STEM activities in the university which are open for higher school students can be useful. As it's described:

"Invite girls into the university and they show them what we what we do here, and they try to do it in an attractive way, and this is especially done for IT or information technologies." (Expert 4)

"I know for my colleagues we also have very good feedbacks from these female high school students because you know for example when we are speaking about ITA, lot of people think that it's only about programming, you know, and this seems to be like very unattractive for the female. But it's it doesn't have to be like that, because when speaking about it, you can have really liked quite a lot of jobs which can be, which can be a very, very interesting also for also for girls. So, they try to show them examples, they try to, they can also do some tasks on their own with the help of our colleagues" (expert 4).

Under the theme Mentorship should focused on comprehensive development, its mentor from all kinds of aspect, including STEM study support, tutor for confident, female role model", "tutor between students, support for language leaning, broaden horizon, female advantages, and support for thesis, so it's mentorship is conducted through all the aspect she can, so it can be defined as "mentorship should be focused on comprehensive development". As she expressed:

We will ask teachers to give them some guide, we will support his professional skills, professional interests and hobbies, in the future can go further in professional science and engineering. (Expert 1)

The measures are for improving his confidence, including professional competence, including strength-type activities, which we have organized to run the group exercised to improve their strength and ability, and then we took them to ski, go karting, and go cross-country. They thought it was impossible. I seemed weak as a girl, but through these exercises, they thought I could break through my limitations and improve my confidence.   (Expert 1)

Inviting experts and scholars abroad, or some prominent women, to give them some lectures, including professional, or how he personally balances family career, how to deal with all aspects of the relationship. (Expert 1)

Providing some opportunities, some stage for students to come and present their research and project, to talk to each other, to inspire each other and so on (Expert 1).

If students pursue further studies, such as going abroad to study for a master's degree and a doctorate, how to write scientific papers and how to take the IELTS exam, then we have a teacher who has a fixed time in one semester to train them, including English pronunciation and intonation, the ability to take the IELTS exam and so on, so that they can smoothly go to further study. (Expert 1)

In April, we visited what DJI company, BGI Company these big enterprises in Shenzhen, and also visited some universities, such as Tsinghua University, Peking University, Wuhan University and so on, as long as there is a chance that we can contact, we took them to go to 20 to 30 students each time,they are all happy about this activities (Expert 1).

Women have their own gender advantages, we do not necessarily say that everyone has become no gender difference, women have female gentle beauty, men have male strong beauty. How to play your gentle beauty, to change the world is our goal, we do not pursue gender equality that everyone become neutral without gender difference. (Expert 1)

Expert 2 believes that Mentorship effort to female should be involved in faculty evaluation. She suggested that mentoring female students is necessary. Therefore, it should be widely promoted, but it should be noted that the "time spent by professors on guidance should be reflected by indicators and included in the reward criteria", otherwise "the workload of professors will be increased, and they may fall behind in academic and teaching work compared with other professors who do not participate".

Time spent by professors on guidance should be reflected by indicators and included in the reward criteria, otherwise "the workload of professors will be increased, and they may fall

behind in academic and teaching work compared with other professors who do not participate. (Expert 2)

The problem is that most of our work as a mentor or service is not counted as a highly reword compared to other parts of work like publication, grant, and all sorts of scholarship work. So think about like many white men faculty do not have a lot of mentees, so what they can pick, so they can spend more time for research. People more like me, we tested a lot of mentees, spent tons of time for mentorship. But in the faculty evaluation, that part is not really counted as important as a scholarship. So it's not really like a fair game women students or people of a college students who need a mentors because they may not receive similar level of support or like information or knowledge from any other places versus other Asian or white students may receive that from their parents or through the parents or network. So I believe that getting mentorship is important. (Expert 2)

The problem is that how it works is, how it works is many institutions use people of color or racially minoritized people and women of color for that labor and they do not really pay back. That's the problem. So. The system is like not really try to provide a program for women or one of the colors. What they try to do is use a similar type of people like women of color staff or faculty for helping similar type of students, women of color students, So they happen to have more additional labor in the system. So that's not fair. But that's what I'm thinking about the mentorship piece. Mentorship is important. Students are very aspired and supported by faculty or professionals through mentorship. But we should not rely on individuals free labor, like how usually happens now in academia. (Expert 2)

An expert holds the view that, as female tutoring is the way to make a change through the individual way. But as the problem located in a structural inequality system, the individual methods can't make a change. But of course, she didn't say the way to offering mentor to female student make no sense, but she doubt the function of this methods. Moreover, she keeps express the ideas that women are not the problem, so it's needed to fix the system and then fix the

women. As she expressed:

It's quite important that we do not try to fix women because they are not the problem. The problem is the structures. So I think if we want to take the root of some of these problems, making a mentorship structure is a way to say that these women need extra support because they have problems, but it's not them that have a problem, it's the way university is structured that present these women with problems. So I think it's the wrong place to put in effort. (Expert 3)

But I'm hesitant to think that this is the way that will solve the problems because I think sometimes it's an easy fix of trying to fix women instead of fixing the structures because it hurts more to say, well, we actually need to do these things differently. Within higher education, it's higher education science that has that have problems in the way that we historically have done things because we normally had like a lot of white men and now we just do the same things even though we have different kind of people inhabiting STEM. So instead of saying, oh, then we need to do extra things for women and from people of other colors and ethnic backgrounds and you know, perhaps we then need to look at the insight of how things work instead. (Expert 3)

So I think that's that that would be my first reply. But then say I also understand and ask sympathetic towards the fact that sometimes it can help women to hear other women's experiences. And I know that the same goes with being colored in a very white setting, that it can be helpful to know that this is not you, that is wrong, but this is the system that kind of make you feel that way. So, so, so it can be helpful to bring people together, but I think that would be the wrong way to go to try to fix problems that are like structurally embedded. (Expert 3)

Expert 4 described the mentor plan for the female student in her universities in the gender equality plan. And the mentor for female student is following the theme "mentorship should be

provided follow the need". Expert 4 believed that mentoring could help. But in her universities plan, the mentoring not only to address the issue of under representation, but perhaps in the meaning to provide some support for females in this mainly male environment (Expert 4). The reason for gender equality tutoring is on the idea that, "we did not want to somehow to spread a signal that we mean, you know, like are not able to survive in this environment or something". Excluding men from the guidance course is deemed inappropriate, as female students do not live in a vacuum, the inclusion of males in the mentorship project is recommended. The way for conducting the mentorship is the guidance should be provided followed the need of student. As is explained, "somebody could or somebody wants to become a professor, somebody perhaps wants to leave university and to go into some other institution, or even to work in a private company", it's a good idea to encourage student to choose the tutor that can certainly help them. As the expert said:

Our internal aim was to have at least 50% of all the mentees to be females, you know, so we were just so we didn't want to like exclude males, but we want to do that. As everyone has its own aim for the future, different people can have could have different type of needs because somebody could or somebody wants to become a professor, somebody perhaps wants to leave university and to go into some other institution, or even to work in a private company. Aiming at helping the mentees to identify their needs in order to progress their career in whatever way. Students will choose their own mentors, but of course, when students can't figure out who should be the tutor he/she choose, we will give help. There should be also some kind of contract between the mentee and mentor in order to set up really cooperation. (Expert 4)

Expert 5 believed that to counteract the influence of gender stereotypes and assist female students in selecting future profession, mentorship is crucial. Because the key problem concerned gender segregation in STEM is that people are influenced by the gender stereotype in the society, which spontaneously influence the opinion of people's expectation about professions. Except directly influence by the people and perspective from the society, the

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influence in the education and the professional selection guidance can come from the teachers. As expert 5 mentioned, teachers' differentiated expectations towards students, acting according to the mechanism of "self-fulfilling prophecy", become in some way prescriptive and prophetic which contribute to the formation of students' personal expectations. It's recommended to add compulsory training in gender culture for teachers, starting from nursery school up to upper secondary school. The gender sensitive course for teachers is a good way to correspond to the influence of gender stereotype which embedded in the mind without notice, to eliminate the obstacle. The guidance should be done in a direction to help student to find their potential and avoiding the gender stereotype influence. As is mentioned:

European Parliament Resolution of 12 March 2013 on the elimination of gender stereotypes in the European Union. The document stressed the gender stereotype in education contribute to perpetuating social/economic inequalities which lead to gender segregation in the study fields and labor markets. And instead of acting as correctives to gender inequalities, tend instead to become vehicles of stereotypes themselves, encouraging girls and boys to follow traditional school and training paths by gender. And the document on the elimination of gender stereotypes in the European Union also pointed out to the professional guidance didn't pay attention to the gender stereotypes in higher education and targeting boys and recommending universities to take action. (Expert 5)

I believe that the most effective system for promoting gender equity in school and academic choices is to invest in sensitive gender orientation; to this we should add compulsory training in gender culture for teachers, starting from nursery school up to upper secondary school. We know well that teachers' differentiated expectations towards students, acting according to the mechanism of "self-fulfilling prophecy", become in some way prescriptive and prophetic because they contribute to the formation of students' personal expectations. The widespread stereotype according to which "males are better than females in mathematics" is internalized by females from childhood and negatively influences mathematical skills and learning because

it influences the perception of one's own abilities: if in males' adherence to the stereotypical conception it increases the consideration of their ability, vice versa in females it affects negatively, devaluing it. (Expert 5)

It is therefore absolutely necessary for teachers to become aware of the gender stereotypes that can influence the school plans and choices of boys and girls and offer everyone the opportunity to choose the educational path that is most congenial, regardless of their gender. (Expert 5)

Cross-disciplinary education is also suggested, including the sub-themes, establishing multidisciplinary platforms and projects, teacher cross discipline, implementation of full credit system in curriculum management. Establishing multidisciplinary platforms and projects means a recommendation on encourage colleges to establish some platforms. Because the colleges are divided by department, so it's not easy to expand the knowledges of different subjects. The platform can bring more opportunities for students and professors from different discipline to communicate. Through communication, the students from different disciplines can enrich the opportunities to cooperate and have the knowledge about other discipline which can be a good project to break the barriers especially the gender barriers between subjects. The sub-themes "teacher cross discipline" provide good way to promote the cross-discipline platform. As teacher is the guide in the university, when professors break the barriers between discipline, the barriers of discipline between students are easier to break. Firstly, the initiative of professors should be promoted through policies, and secondly, professors should be used as leaders to lead students' cross-professional cooperation and communication.

Full credit system in curriculum allowing students to freely choose their favorite professional courses, to promote cross-disciplinary exchanges and promote the overthrow of gender barriers in disciplines. It can be a good idea to promote the full credit system, because on this base, students can choose majors they are interested in and widen knowledges on different majors. But the problem come from management, as the expert mentioned, it brings difficulty for teacher to manipulate the time for classes, which means is difficult to adjust the time for students

from different discipline. But it's still worthy concern, how to bring more opportunities to widen students access to the subject not just their major and widen the interest and possibilities of students of different gender. The experts' ideas are expressed:

In this interdisciplinary field, it has a role to play in helping students grow, and it should be done. So how do you do that at that school? I think that many of our domestic schools are divided into disciplinary professional colleges, which makes the interdisciplinary aspect may not be so smooth. For example, if you are a professor, you belong to a certain college and a certain major, then how can you go interdisciplinary ah. Therefore, in terms of schools, I think there should be some platforms, so that teachers can cross-discipline, and naturally he will bring students to cross-discipline, and then build some public platforms, such as public laboratories, entrepreneurship and innovation centers, so that students can have the opportunity to learn in different, that is to say, in a unified place, although you come from different disciplines, But you have a chance to communicate. (Expert 1)

As for this platform, schools can carry out some projects to involve students, or some training and training, that is, they will carry out some personnel training work according to this platform and this center, and students will naturally benefit. Only when the student knows something about other majors can it come and go. I think the school can do this from the platform building. And from this management this and this for example does it have incentives for, you know, teachers, you have to cross disciplines, and from this management aspect, for example between faculties, or departments or majors within the same faculty, well, is there even some kind of program, or some kind of support that can be done? I think schools should be able to use these measures to help. (Expert 1)

We have implemented the college system since 2008, and before the college system, we had a mixed system, which means that students in your dormitory, in our old dormitory, including many students in the current dormitory, all live in the same dormitory, and the students in the

same major and the same grade, so that the people they know, and their usual communication are very simple. In 2003, our school began to implement the mixed housing system, which means that when a student goes to the dormitory, there are students of different grades and different majors, so it is natural that there will be subject exchanges. (Expert 1)

In terms of curriculum, you can implement the full credit system, for your students this course, you are different grades and different majors students can choose. It's a full credit system, you take the class in a classroom with different grades and majors, and you make it compulsory for that student. For another major is elective, full credit system, he is calculated by credits ah. And then, on a course basis, let me give you an example, let's say, uh, a computer science major, so he's good at English, and then, uh, his English major, he's starting a course on, uh, simultaneous translation, and this computer science major, he's good at English, he's interested in simultaneous translation, uh, He can take this course for English majors, which is a compulsory course for English majors, but an elective course for computer majors. So everyone can, take the course in the same class for the credit. This is an example of a full credit system. (Expert 1)

As gender gap in STEM is a complicated issue which located in the gender stereotype in the society and there are a lot of factors that functioning, it's not easy to change itself. Gender quote as a methods that aiming at directly change the sex ratio to make a difference，has always been suggested. With the worry that the women face a lot of obstacles in the system with the gender stereotype and the system inertia that male will choose male as professor or person in the top leader team. With the status quo that is mentioned, when is suggested that there should be one female in the upper power class, then there may be only one female. This phenomenon not only indicated that the rule would work if is presented, but also implied that it could be a change just on the surface. But as are issues that exist for a long time, it will not change that fast, external intervention is necessary. Moreover, the gender quote is suggested as a transition before gender equality achieved, the progress and effect of gender quote policy should be monitored, it should

be changed when the gender ratio have positive advance. As is mentioned:

If it is stipulated that at least one vice principal must be female in a university, then there may be only one female in the upper power class of the whole institution of higher education, and the others are all men. In fact, in this process, you can stipulate not at least one person, but at least what the percentage is, then I believe that there are a lot of things that you give him the opportunity to cultivate, he will naturally rise, not to say that yours must not work. (Expert 1)

When we look at the reality, usually that's not happening and the problem like equity issues usually do will not be fixed in couple of days. People who are actually working in the real policy field try to fix everything like so quickly, but it doesn't work. (Expert 2)

I think looking at the positions that are being announced, it's in certain areas often because someone is recognized as clever or good or productive and that is gendered so. So there will be a lot of women that would never be recognized of their talent because the structure is not supporting them and it does not I think all the research show this will not change by itself. (Expert 3)

So, and I think quotes could be one way to try that out for a couple of years and see how then we will perhaps have some other people like a broader diversity of people inside. (Expert 3)

Because this high position is still a lot of men, so when they think about it, they may often think that ah, first because he is a woman, so let's not worry about it, we want a man, which is currently in this kind of organization, institution, I think it is quite common, this is difficult to change the consciousness. (Expert 1)

But now in the process of gender equality, when you are fully equal · not use it anymore. (Expert 1)

As is suggested by expert, the vulnerable groups should be pay attention to. In the example expert provided, the vulnerable groups are the groups that need the attention of the policy and at the same time, the problem and issue for the vulnerable groups can be a different situation. So, the policy needs to pay attention to the vulnerable group, or the effect of the policy will be limited. As is expressed by expert:

So gender bias does not really only talking about how people perceive a women, but you should think about like how people perceive women from poor family, women from single mom parents women who are person of color, women who have immigrant histories, STEM fields often assume that as a very male white middle class or high income middle class background. (Expert 2)

Everybody believes that if you are doing internship throughout the undergraduate education, it would be really helpful for you to get a job and for your career, but we have a many students who have a full time job or commute who do not stay on campus, they take a classes and come back to home and they have a full time job which means that they taking courses online during their lunch hour or they are taking courses at night or they cannot take any like a break like certain time of like 2 weeks, 3 weeks of break because like they have a full time job and also they have a family members who they need to take care of", for these kind of student, internship doesn't work well. To make the policy work well, "they have to think of like more micro, macro or like broadly and narrowly in many different parts of it and then implement that policy otherwise it will not work. (Expert 2)

Incorporating gender equality as standard for funding is a big progress in European union which provide a good start for the gender equality action. With the effect of gender equality plan as a standard for applying for funding, it's very efficiency. It can be useful also embedded gender as an aspect for applying for funding and rewards in the country level. Because the progress of

gender equality needs funding and putting gender equality as standard for funding is motivative for the gender equality action. As is suggested by expert:

I think the first course in diversity is currently in construction and that is because the EU, when applying for EU funding, you need a course in gender equity in terms of applying for these funding. So I think then the universe, yeah, so then the university now begin having some of these courses. But I think the push is coming from industry, economic discourses and EU policy rather than like, yeah, a matter of university wanting to change practices by themselves. (Expert 3)

If there would be requirements on gender equality measures, which would be included into the into the requirements of the national funding, have any, so this will help us really a lot. (Expert 4).

So basically, all the institutions which are doing some general quality works are able to apply for grants for national grants in UK. But we do not have something like this in in Slovakia. (Expert 4)

And on the level of university, it's always a problem to find a budget when you do not have a project you know, and the university has a problem. (Expert 4)

For example, when the Ministry of Education would prepare like special grants just for establishing of the position of Gender Equality officer at universities and it will be great. (Expert 4)

Yeah, because with money we start everything and unfortunately, we can also finish everything when we do not have budget, when we do not have money. (Expert 4)

V. DISCUSSIONS AND OBSERVATIONS

This chapter aims to review and discuss the research questions in this paper:

a)   What are the characteristics and positive actions of policies that effectively promote gender equality in STEM higher education?

b)   What are the commonalities and differences of priority of current policy in Italy and China to promote gender equality in STEM in HE?

c)   On the historical background of Italy and China and the situation of gender equality in STEM HE in Italy and China, what can we learn from the different meanings, implications and outcomes of policies in Italy and China to provide a conducive inclusive, equitable and quality STEM education environment?

d)   What kind of polices can be benefit in promoting gender equality in STEM from the perspective of the state, institutions of higher education, and individuals?

5.1 Policy Progress and Challenges: from the Policy Comparison between Italy and China

5.1.1 Policy Contextual Background Comparison between Italy and China

For more than 2,000 years, the Confucian hierarch confined Chinese women to the domestic sphere (Yun, 2013; Skromme, 2007). Before marriage, women as daughters were the property of their parents; after marriage, women as wives were subject to the authority of their husbands; and after their husbands died, women as widows were required to obey their sons or mothers-in-law (Zhou,2003). The social shackles strictly prohibit Chinese women from participating in social activities, and require Chinese women to be good daughters, good wives, and good mothers-in-law (Croll, 2011, Zhou,2003). Son preference still popular in some part of China. In the seventh census, the sex ratio at birth was 111.3, down 6.8 from 2010, indicating that China's male preference has weakened, but still exists (usually the male sex ratio at birth is

between 103/107, and there are more than 110 males for every 100 females born). After the founding of New China in 1949, "gender equality" was written into the Constitution, which legally recognized the status of women (Cao, 2022). In addition, China's first Marriage Law, passed in 1950, stipulated that "the feudal marriage system of arranged coercion, male superiority, and disregard for the interests of children should be abolished. abolishing oppression, coercion, and the feudal system (Han, 2023; Altehenger, 2015). The new democratic marriage system of freedom of marriage, monogamy, equal rights of men and women, and protection of the legitimate rights and interests of women and children shall be implemented (Qiuxin, 2015). In 1957, eight years after the founding of New China, the whole society held high the banner of building socialism, endeavoring to fully liberate women, and entered the period of women's Great Leap Forward (Zhong, 2010). The Communist Party of China has played a key role in improving the status of women, and since its rise of power since 1949, the Communist Party of China has changed society's attitude towards women's social status through propaganda, policy and legislative means (Howell, 2008).

The history of Italian women starting to fight for their rights can be traced back to the Italian woman writer Christine de Pizan's book *Le Livre de la cite des dames* in 1405, which depicts a city where women are respected and appreciated, and their rights are defended. It also points out that the low status of women is not an innate defect, but a lack of education (Willard, 1984). However, it was not until 1877 that the Russian Ernestina Paper (1846–1926) obtained her medical degree in Florence. But until 1946, Italian women could vote for the first time. Then the women empowerment still progresses slowly, as both right- and left-wing political parties shared a "familism" ethos based on the notion that the traditional family formed the cornerstone of social order and the primary supplier of social protection (Lombardo & De Giorgio, 2013). In 1870, there was a wage for housework movement in Italy, which demanded financial compensation for women's housework. in 1970, a law regulating divorce (Law No. 898/1970) received approval. In 1977, the Italian Parliament passed a law on equal treatment between working women and men. In Italian tradition, there is a particular welfare system which the family takes on the role of a social buffer, to provide emotional and practical support to family

and family members, which still affects the life and learning choices of Italians (Sundström, 2003). According to ISTAT (2020), the employment rate for women in the Northern Region is 59%. The female employment rate in the south is stuck at 32.5 per cent, with only a few regions (Campania, Sicily) reaching 28-29 per cent. The incidence of NEETs (young women not in education or employment) in the 15-29 age group is 19.7% in the north and 34.2% in the south, with the highest being 36.2%(Campania) (ISTAT, 2020). Female graduates or those with other higher education qualifications in the 30-34 age group account for 37.1% in northern Italy and 27% in Southern Europe (ISTAT,2019): In both regions, the number of female graduates exceeds the number of male graduates (25.6% and 15.8% respectively), although it is still well below the European average (46.1%). This confirms not only the gender gap and regional inequalities in female employment, but also the "Italian paradox" that an increase in the number of qualified women does not mean an increase in the number of employed women. Moreover, most women prefer to choose education, nursing, and other female majors, which can be seen that the concept of women's family role is still deeply influenced. While women are by far the most represented gender among graduates in teaching, psychology, and law (94%, 81% and 64% respectively) (Almalaurea, 2019a). At bachelor's level, women constitute the vast majority of students in the fields of education and training (93.1%), linguistic (85.1%), psychological (81.5%), medical-health (75.6%) and art and design studies (71.8%).   Conversely, they are underrepresented in fields such as ICT (13.7%) and industrial and information engineering (26.6%) (EU et al., 2022).   A similar distribution is found at master's level: there is a strong prevalence of women in the areas of education and training (92.7%), linguistic (85.8%) and psychological studies (81.9%) and art and design (74.4%); though it remains limited in ICT (18.5%) (EU et al., 2022). In advance, these still support a view of women as subordinate to men, with such stereotypes being equally prevalent among men and women (ISTAT, 2018). In Italy, the most common stereotypes about traditional gender roles are "it is more important for men to be successful at work than for women" (32.5%), "men are not well suited to housework" (31.5%) and "it is a man's responsibility to provide for the family" (27.9%) (ISTAT,2018). The statement "Men make the most important decisions about the family" received less support

(8.8%). Among those aged 18-74, 58.8% had one or more such beliefs (ISTAT,2018). There was a relatively small gender gap in terms of level of agreement; however, the proportion of agreement increased with age, with 65.7% in the age group 60-74 years old (compared with 45.3%) and in the age group 18-29 years old (45.3%), as well as in the age group with less education (ISTAT,2018). The prevalence of gender role stereotypes is highest in the south of Italy at 67.8%, mainly in Campania and Sicily (71.6%), lowest in the north-eastern part of Italy at 52.6%, and lowest in the Friuli Venezia Giulia region at 49.2% (ISTAT,2018).

Through the comparison of historical analysis of policy discourse，although the development of gender equality in China and Italy is involved in the global process of the gender equality movement, gender equality in China and gender equality in Italy have experienced different processes. The reform of gender equality in China is a top-down reform, through the CPC and its related institutions to actively transfer power through the promulgation of laws and policies. Such a transfer makes it easier for women's rights to come, the theoretical basis for women's rights reform is relatively weak, and the inertia to promote change from a political perspective is weak. Top-down reforms are often driven by economic development imperatives and by treaties and initiatives by international bodies such as the United Nations, the World Human Rights Organization, UNESCO, and others. Although the progress of gender equality in Italy was fought for by women, the slow or even stagnant history from the incorporation of gender equality provisions in the Constitution to the practice of women obtaining equal rights in the family, as well as the investigation of Italian stereotypes, show that there is still a great resistance to breaking through the traditional gender roles in Italy and the influence of family roles. Especially in China, the history of fighting for equal opportunity for women in STEM is in coherence with the struggle for gender equality, but the STEM gender equality in pedagogy and through education is ignored.

From the perspective of most Chinese people, gender equality in China's higher education is equal to the equality of total ratio of female student in HE, especially equal in admission score of college opportunities. The concept of gender equality remains at the stage of formal equality related to the equal admitted scores and the total ratio of female student in HE in China, while

the research on substantive equality has not been advanced. The comprehensive understanding and reform of gender issues in higher education lack of the internal drive from the HE institutions themselves. Reflecting on history, in the period of China's reform and opening up, due to the realization that science majors in modern science have the potential to change society, China's slogan for education at the beginning of the reform and opening up was "learn mathematics, physics and chemistry well, and you are not afraid to go around the world". Under the leadership of such reform and opening up slogans, coupled with the inclination of national policies, China has formed a social stereotype in the reform and opening up period that "mastering mathematics, physics, and chemistry makes you fearless wherever you go". The study of science and engineering is promising, and China has cultivated a large number of STEM talents. The influence of such a slogan is extensive. Women were also guided by the slogan at the beginning of the reform and opening up, and more female students broke through the traditional restrictions and chose to study science and engineering. Coupled with the one-child policy and actions to promote girls' education, girls in cities have received more material training, while girls in rural areas have also received more material and environmental support in their development, and gender equality has made great progress in the dividend period of rapid development of higher education. In the newly issued "Several Measures to support female scientific and technological talents to play a greater role in scientific and technological innovation" and "Opinions and Policies on the Implementation of Women's Actions in scientific and technological Innovation", the development of female scientific and technological talents is regarded as an important breakthrough in the development of STEM innovative countries and scientific and technological powers. In the process of building an innovative country and a strong science and technology country, it is an important policy direction to promote female STEM learning and help female scogyientific and technological talents stay and develop in the field of science and technol. Due to the different national policy orientation, Italy mainly regards the development of women in STEM fields as an important way to develop Italian women and promote gender equality. However, the development of female STEM talents in both Italy and China needs to overcome structural obstacles and inertia, and changes need to be

carried out through policy support.

Gender segregation in STEM is different in China and Italy. Italy is less segregated than China, where academic segregation is more pronounced. The dynamics of gender segregation in STEM fields is different between Italy and China, Italy exhibits a lower level of segregation compared to China, where academic gender disparities are more prominent. Italy has basically achieved gender equality in science majors, and China has basically achieved gender equality in the theoretical disciplines of science majors, but in the more technical disciplines of science majors, the gender is still unbalanced. However, in the field of mathematics, particularly in applied mathematics, China has managed to reverse the gender gap. This may relate to the ongoing discussion that "Chinese people are good at math" and that the math component of basic education in China has a positive effect on improving grades and laying a good foundation for math. The math study case of China also showed a potential of promoting studying STEM through enhancing STEM standard subject study like math and science before college.

In Italy, the gender reversal in biology and its related majors has lasted for a long time, and the reverse gender gap in biology and its related majors has been generated, girls account for 70 percent of the number of majors, and boys have become a gender segregated group. In mathematics, physics and related majors in Italy, although the gender balance is basically achieved, the gender ratio of mathematics and physics majors shows an opposite trend, and the positive choice of women for mathematics learning shows a downward trend. In the international basic academic performance statistics, Italy's mathematics level is below the international average. Mathematics has long been considered the foundation of all STEM majors, and it is believed that grades and achievements in mathematics majors can influence the choice of STEM majors. In fact, math is a language, and people's interest in and introduction to STEM (or most of them) is based on math, and therefore a necessary "enabler" for the future of equal opportunity, so this small change and why is still worth paying attention to. Indeed, mathematics is a language for STEM study. People's engagement with and entry into STEM fields is often rooted in mathematics. Therefore, math serves as a vital "enabler" for future equal opportunities. Hence, even this subtle shift merits attention and consideration. China and Italy

both have a large gender gap in engineering and computer majors, which is an important aspect deal with gender segregation in STEM disciplines and promoting gender equality.

5.1.2 Positive Actions and Challenges: Policy Comparison between Italy and China

Through the thematical analysis of the policies, it can be found that the lens of education is lack in the policies of China and Italy on promoting gender equality in STEM. In the part of vision of policies, although China's policies mentioned the right to education, gender imbalance in the field of science, the rights of women as a special vulnerable group, the promotion of education equity, and the shaping of an environment for free and all-round development, inclusion has not directly been used as a policy discourse in the field of education. In Italian policy, inclusive policy discourse is not linked to gender.

From the SDG goals 4 and 5, inclusion in education cannot be achieved if it fails to response to all learner's need. As it's used in 2020 Global Education Monitoring Report, inclusion is a state of affairs, a result, a process that actions and practices that embrace diversity and build a sense of belonging, rooted in the belief that every person has value and potential and should be respected. Inclusion and equity in and through education is the cornerstone of a transformative education agenda, and we therefore commit to addressing all forms of exclusion and marginalization, disparities and inequalities in access, participation and learning outcomes (UNESCO, 2015, p 3). Increase the system's ability to respond to learners' diverse needs, support the weakest, while encouraging the strongest to achieve their best, and ensures all members feel respected, valued, and are enabled to fully participate in the school community (EASNIED,2017, P 7). From the vision of Chinese policies, there are themes development and gender equality, human right, quality education being mentioned. The policies draw out a vision about the development of the country to be a powerful country in science and technology with the contribution of female talent and full development of women. The gender equality is also the main vision with the potential to promote gender equality and through gender equality to foster the development of STEM fields development. Taking all the themes concerned vision

of Chinese policies, the value of inclusion is missing in the vision of the policies, but in the initiatives to promote gender equality in STEM HE, some measures concerned eliminating gender stereotype through gender equality education or guidance.

One of the general needs of female in education is eliminating the gender stereotype which limit female students' potential. From the thematic analysis of the policies, we found that although from the Convention on the Elimination of All Forms of Discrimination against Women adopted in 1979 and the Beijing Declaration and Platform for Action(BDPA) in 1995 had already shed light to the gender stereotype in the society which limit women's potential, and in the field of education, the policies in Italy and China still not as focused as enough in building a gender sensitive and gender inclusive environment in tertiary education level. As the Convention on the Elimination of All Forms of Discrimination against Women, adopted by the United Nations General Assembly on 18 December 1979, solemnly recognizes that cultural and traditional influences limit women's enjoyment of their fundamental right and the forces of culture and tradition take the form of stereotypes, customs and norms that constrain the advancement of women legally, politically, and economically (UN Women, 1979). With this direction, the following article 5(a) suggested the need to eliminate the gender stereotype that led women to specific social role. The article 10(c) The Convention on the Elimination of All Forms of Discrimination against Women suggested revision of textbooks and school programmed and the adaptation of teaching methods to eliminate any stereotyped concept of the roles of men and women (UN Women, 1979) and the Article 74 and article 75 of Beijing Declaration and Platform for Action pointed out the need to bring gender sensitive to all the dimensions of education which are all suggested an educational way to make a change. The Articles 72 of Beijing Declaration and Platform for Action suggested a sensitive and inclusive world for everyone to achieve their potential. But as is suggested in the Italian policy, although it hold a vision to build an inclusive world for everyone to achieve their potential(policy 6,policy 7), it fails to focus on the gender sensitive way in the higher education where gender segregation express obviously ·with the higher education missing the gender dimension in policy concerned gender equality education, and education guidance. The article 80 d) of Beijing Declaration and

Platform for Action calls upon Governments to take measures to establish gender-sensitive education systems in order to ensure equal access to education and training. Gender-sensitive professional learning counselling and vocational education programmes encourage girls to take academic and technical courses to broaden their future career opportunities. Although it suggests in the Chinese policies to build a decision-making gender-sensitive professional learning counselling and vocational education programmes and encourage girls to take academic and technical courses to broaden their future career opportunities but failed to suggest the guiding courses in the HE in a gender sensitive way. The guiding for specific excellent women is suggested than a gender sensitive guiding courses for all. In the Italian policies, as the guiding policy (policy 10) is just focused on the direction from higher school to universities but didn't mention the guiding in universities. And when the guiding from higher school to higher education is mentioned in the policy, it didn't mention that it should be focused on a gender sensitive way to help girls eliminated the influences of gender stereotype. What's more, the instruction for gender equality in the student professional guiding should focused on the way of eliminating the gender stereotype influence was mentioned in policy 6 and policy7, so the policies is not conscious with each other. From the policies analysis, the policy in Italy and China haven't been dedicated enough to follow the suggestion from the Convention on the Elimination of All Forms of Discrimination against Women adopted in 1979 and the Beijing Declaration and Platform for Action which are important direction for achieving gender equality.

Article 5(a) requires that States Parties shall take all appropriate measures: To modify the social and cultural patterns of conduct of men and women, with a view to achieving the elimination of prejudices and customary and all other practices which are based on the idea of the inferiority or the superiority of either of the sexes or on stereotyped roles for men and women(UN Women, 1979). Article 10 (c) requires States Parties to eliminate any stereotyped concept of the roles of men and women at all levels and in all forms of education by encouraging coeducation and other types of education which will help to achieve this aim and by the revision of textbooks and school programmed and the adaptation of teaching methods (UN Women, 1979).

Article 72 calls for the creation of an educational and social environment, in which women and men, girls and boys, are treated equally and encouraged to achieve their full potential, respecting their freedom of thought, conscience, religion and belief, and where educational resources promote non-stereotyped images of women and men, would be effective in the elimination of the causes of discrimination against women and inequalities between women and men(UN Women,1995). Article 74 states that Curricula and teaching materials remain gender-biased to a large degree and are rarely sensitive to the specific needs of girls and women (UN Women,1995).

Article 75 stated that science curricula in particular are gender-biased and science textbooks do not relate to women's and girls' daily experience and fail to give recognition to women scientists (UN Women,1995)

To eliminate gender stereotype the Italian conducting initiatives from cultivate female STEM interest before universities, providing academic support to enhance math and science study before universities, provide guidance courses for profession selection, providing gender equality education to learn respect, reserve place for female in some majors that lack of female students. Through widen access of female students to STEM can alleviate the influence of gender stereotype. In the guidance courses guidance, the gender-sensitive part is not coherence, when in the policy aimed at promoting gender equality, it suggested that the guidance should be done in a way that is gender sensitive, the gender-inclusive way is missing in the official document of guidance. But in the process of HE, the initiatives is not sufficient, only with the demand of gender equality plan which is suggested by European union as the foundation of getting fundings. In the Chinese policies, the access justice is made sure by equal scores for admission. The methods of cultivating female STEM interest, gender equality education is also mentioned. In the process of HE, the sensitive education methods are not mentions, but there are a lot of supporting methods for excellent female student instead of to female student in STEM in general. There is no institutional gender equality plan of university in China compared to Italy.

Eliminate gender disparities in education and ensure equal access to all levels of education and

vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations is the goals of council of Europe plan for achieving gender inclusion and equality (European Agency, 2015, p. 1). Form the analysis of Chinese polices, the vulnerable peoples mentioned are the people in poverty. As the academic development in China is not balance across different regions, the women from the poor regions face bigger difficulty concerned achieving gender equality. What's more, "the rights and opportunities of girls in underdeveloped areas, left-behind girls, children of rural migrants and girls with disabilities to receive education are guaranteed; support girls with academic difficulties to complete compulsory education and improve the retention rate of girls in compulsory education" is also put forward as the goals for promoting gender equality. But in the part of promoting gender equality in STEM, the vulnerable groups are not mentioned as one of the targets. It reminds that in the process of promoting gender equality in STEM HE. The remedy of women's own intersecting vulnerability should also be a target, and the difficulties caused by other vulnerable identities besides gender identity should be investigated and promoting data collected concerned to introduce corresponding measures. In the Italian policies, more types of vulnerabilities are mentioned, including disability, social and economic hardship, violence, labour exploitation and gangmastering suggested in policy 6 and disability, ethnicity, religion, personal beliefs, and sexual orientation in policy 11. The ways of promoting the gender equality including vulnerability including mainstreaming the gender perspective associated with vulnerabilities, providing additional support for pregnant female college student, and monitoring should include the women with disabilities. Although the policies actions are a little bit separated, but the methods like the mainstreaming vulnerability women in gender equality process shows concern for vulnerable groups of women. The policy directions could be improving the attention of vulnerable groups of women in policies in a comprehensive way especially in the part that promoting STEM gender equality.

Inclusive education guides all educational policies and practices, intertwining different dimensions (access, processes, participation and learning outcomes), levels (formal, non-formal, adult education) and units (national frameworks, curricula, schools, classrooms, teachers and

learners). From the thematic analysis of policies in Italy and China, gender equality education framework, guidance framework and institutional equality framework are recognized in Italian policies; gender equality education framework, human right education framework, gender equality in STEM framework are recognized in Chinese policies. For the Italian policies, the gender equality education framework and guidance framework are not comprehensive and ignore the higher education level. The gender equality education framework including education levels from primary school to high school. The standard for different education level is different: "accept and welcome diversity, understanding the reasons and above all using them as a resource for solving problems, performing tasks and development of projects; take care of your language, avoiding improper expressions and offensive" (primary school); "identify the elements that contribute to defining one's identity and strategies to harmonize any contrasts that characterize them" (secondary school of I degree)"; "identify ethnic, social and cultural stereotypes and prejudices present in one's own and in attitudes and behaviors of others, in the mass media and in study and research texts" (secondary school of II degree). The content including education on gender equality and respect for differences, the feminine and the masculine in language, prevention of violence against women, prevention of all forms of discrimination, the fight against discrimination in the digital world, education to respect at school. The focus of the gender equality education in policies including textbook without gender stereotype, teachers' disciplines and work must be sensitive to gender difference differences. The guidance has a gender-sensitive directions to eliminate the influence of gender stereotype, understanding diversity and value, learning to respect the diversity and difference. But the universities missions and directions are not specified. The guidance framework including education levels from secondary school to high school. The units including teacher training, promoting the study of STEM disciplines, promoting students go to universities. But the guidance is separated from guidance for choosing professions in a way that eliminating the influence of gender stereotype. One of the main goals of the guidance is promoting more students to go to universities, but the university part on choosing future targets like profession is missing.

For the policies in China, the gender equality education framework is constructed from all education levels including primary school, middle school, high school and university; the units including education department issues guidelines on gender equality education, schools promote the development of gender equality courses, schools strengthen teacher training, schools promote the integration of gender equality education into school teaching content, campus culture, club activities and social practice; the modes including the combination of school education, family education and social education. The human right education framework is constructed from the education institutions including primary school, secondary schools, universities and national human rights education and training bases. The units including incorporating the human rights knowledge, such as the value of life, awareness of equality, protection of privacy, and rights and interests of minors, will be into the relevant curricula, enriching educational methods and means, expanding educational practices, support institutions of higher learning to set up human rights-related professional courses and general courses, and compile human rights-related teaching materials. Strengthening the construction of human rights disciplines and personnel training. To explore the establishment of human rights teacher training centers in normal schools, strengthen the construction of national human rights education and training bases and add three more. Gender equality in STEM framework is constructed by units including support female science and technology talents to undertake science and technology plan projects, give better play to the role of female science and technology talents in science and technology decision-making consultation, support female science and technology talents to participate in international science and technology exchanges and cooperation, expand the scientific research and academic network of female science and technology talents, promote the implementation of the retirement policy of female science and technology talents with senior titles, vigorously support female science and technology talents to innovate and start businesses, and improve the evaluation and incentive machine for female science and technology talents, support the scientific research work of female scientific and technological talents during pregnancy, strengthen the training of female reserve scientific and technological talents, strengthen statistical and research work, and strengthen institutional

guarantee. The subject involved in the measures for promoting gender equality including Women's federations at all levels, science and technology Department (committee, bureau), SASAC, trade unions, Association for Science and Technology, units of the Chinese Academy of Sciences, units of the Academy of Engineering. The subject including wide institutions which can be positive in promoting an inclusive society environment for the development of female in STEM. The STEM gender equality education framework constructed by initiatives from different education level from primary school to universities. The initiatives units for different education level are different. For the education level before university, the initiatives related to cultivate the female student's STEM interest and improve knowledge and science experience through activities and competitions. In high school level, it focused on guidance of profession focused on eliminating gender stereotype influence. For the university level, it focused on educational support and financial support. Although the policies on promoting gender equality in STEM in education didn't focus on gender-inclusive perspective which aimed at gender-sensitive study materials, gender-sensitive teacher training, but it still focused on eliminating gender stereotype influence through guidance.

Identifying needs and deficiencies is the basis for formulating policies and taking actions. Concerned which kind of need data should be collected, from the policies analysis, the "need" should be new and reality. But concerned the concept of "need" for gender exclusion situation, it still depending on the country itself to decide which kind of data should be collected. For most countries, the policy explicitly focuses on special needs provisions that learners may require, not just learner factors such as disabilities or impairments (Acedo et al., 2011, p 104) EADSNE have agreed that the most useful approach to collecting any form of data on special needs education is to take a "bottom-up" approach that uses the country's own legal definition of SEN as the basis for data collection (Acedo et al., 2011, p 105). From the policy perspective of the identification of female need in STEM in higher education, China's policies have limitations on the requirements of identification of need and policy formulation. There are limitations to the actual data and research related to China as far as the first theme Statistics and research is concerned. The Ministry of Education of the People's Republic of China releases

educational statistics every day, which are divided into two parts: national basic situation and local basic situation. The statistical subitems of the basic situation of the country include the situation of students at all levels of all types of academic education, the situation of students at all levels of all types of private education, the number of female students at all levels of all types of schools, the number of students in higher education schools (institutions), the number of graduate students by subject (total), the number of graduate students by subject (ordinary colleges and universities), the number of graduate students by subject, the number of ordinary students, and the number of students by nature and category of junior college, and the number of ordinary undergraduate students in different disciplines. However, the total number of female students majoring in science and engineering cannot be found in the data base of ministry of education, and the complete count of female students pursuing science and engineering majors remains elusive. For example, when log in the data base website of ministry of education in China in 2023, these options can be found in the general undergraduate statistics options: Comprehensive Universities, Polytechnic Universities, Agriculture Universities, Forestry Universities, Medicine & Pharmacy Universities, Normal School Universities, Language & Literature Universities, Forestry universities, Medicine & Pharmacy Universities, normal school universities, Language & Literature universities, Finance & Economics Universities, Political Science & Law Universities, Physical Culture Universities, Art Universities. The total number of students in this school is broken down by type, but the number of female students is only presented as the total number of female students in all subtypes of colleges and Universities. In the data base website of minister of education of China, the statistical data of the number of undergraduate students by subject Philosophy, Economics, Law, Education, Literature, Foreign Language, History, Science, Engineering, science and technology from can be found. Agriculture, Medicine, Management, Art Graduates, Entrants, Enrolment, Estimated Graduates for Next Year can from 2017-2021 be found. The total number of graduates, entrants, enrolment, and estimated graduates for next year in all majors also can be search for in the sdata base website of minister of education of China. Unfortunately, there is a lack of data regarding the number of female students in each specific major. Similarly, in other categories of data, only

the number of girls is presented as the total number of all students, which shows that there are more girls than boys in higher education. In fact, according to different majors, different types of schools, the gender gap is more obvious. From the official data published by the state, it is impossible to recognize the enrollment, study and graduation of female students in different majors in higher education, nor can it understand the specific data and proportion of male and female students in different types of higher education institutions, and it is impossible to analyze the development of female students in different majors of higher education through the data of female students in different years, and the status quo of gender segregation. The lack of specific data reflects the low level of attention paid to this issue, the superficial understanding of gender equality in higher education, and the total number and proportion of women in higher education as the criterion for judging the status of gender equality in higher education, which is not conducive to the reduction of gender segregation and the realization of substantive gender equality. There is also a dearth of literature on gender equality in higher education in China. Through a search on CNKI (deadline 16/09/2023), 115 articles on gender equality in higher education were found, including 63 academic journals, thesis, and dissertation of higher education student 39, conferences 5, newspapers 1. We found 130 papers on women in science and engineering, including 104 academic journals, 11 thesis and dissertation of higher education student, and 1 conference. There are 21 literatures on gender segregation in higher education, including 16 academic journals and 4 thesis and dissertation of higher education student. With female engineering majors as the subject, 27 papers were found, including 12 academic journals, 6 thesis and dissertation of higher education student, and 1 conference. The citation rate is also very low, and the number of sci documents found in the form of advanced search (those with higher quality in the literature) is almost nil. From the research level, to understand and recognize the actual needs of female students in STEM higher education, the support of research is needed, and the lack of research support is difficult to formulate policies according to the actual situation. What's mostly sedated for both country is the deepness and refining area for gender equality data, which should monitor the implementation of policies especially in the departmental level.

5.2 Policy Challenges and Active Actions: from the Expert Interview

5.2.1 Gender Role Consciousness Rooted in and Reinforced by the Society

Gender role consciousness rooted in and reinforced by the society is one of the most difficult parts for dealing with the issue of gender gap in STEM. As is emphasis by expert 5, the educational choices of female students, like those of male students, are not at all spontaneous and intimately desired, but, on the contrary, are bound by a sexist imagination that imposes on both (male and female), the routes deemed suitable for the genre to which they belong. The gender stereotype come from the society become part of our consciousness, and presented in a way that is spontaneous. This issue has several difficulties like, the gender equality will not spontaneously change, it takes a long-term to change. What's more, as this imaginary is continuously nourished by the messages proposed by families, by the mass media, but also by the school itself, which bring more difficulty to make a difference. With this social boundary, it's suggested a way to change it through involved gender in education. Expert 3 suggested to involved gender sensitive training as the mandatary course for new teachers. Expert 5 suggested to involved gender-sensitive dimension into the guidance course for students through the gender-sensitive teacher training. One of the experts used his own experience to introduce the different gender sensitivity training methods for university personnel of different identities. For university administrators, more attention should be paid to the gender neutrality of language and the elimination of possible gender bias in the process of work. Gender-sensitive training for teachers focused on the inclusion of gender in teaching, and one of the experts mentioned that gender-inclusive teaching could be promoted through the evaluation and monitoring of teachers' teaching. The creation of gender-inclusive, equal quality environments is not easy. There is a gap between policy and reality. As expert 2 pointed out with her practice and experience, the policy implementation route envisioned by the policy promulgators is often different from the reality, so the practice process and effect of the policy are very worthy of attention and follow-up.

5.2.2 Negative Ideas and not Easy to Mobilize

As the expert knowledge pursued in this paper includes expert expertise and expert practical knowledge, one of the practical knowledge of experts is that experts work in colleges and universities and pay attention to research and project implementation in the field of STEM gender equality, so they should have a relatively good understanding of STEM gender equality measures in the field of higher education. Through the data on the implementation of gender equality policies in colleges and universities obtained in this paper, it can be inferred that gender equality issues in colleges and universities have not received enough attention, and there are few relevant measures.   In addition, it is difficult for STEM gender equality issues to get the attention of the personnel in this discipline. Because the personnel in this discipline attach more importance to the research and development of STEM disciplines, and the majority of them are men, it is difficult to form a concern for gender equality issues, which becomes an obstacle to the implementation of policies. Through the narration of the five experts on the policies they have implemented, it can be found that experts 1 and 3 have made a distinction between the gender equality measures they have implemented, and the gender equality measures implemented by colleges and universities. Expert 1 is the executive of the STEAM project, which is carried out in the Women's College of Shantou University, China, which is not a college of the university, and its funding is provided by the Li Ka-shing Foundation, with the aim of promoting women in STEM fields to achieve higher academic achievements in STEM. And gain the competitiveness to match men in society in order to overcome the gender bias against women that may be encountered in employment. But Expert Yi denies that Shantou University, where the academy is located, has a school policy that helps promote gender equality, and believes that no other school has one either. Expert 3, a researcher in the STEM gender equality subject area, claims to have taken the initiative to support the formation of gender-focused institutions in the Academy and to promote the expression of gender perspectives in decision-making. However, regarding the gender equality policy in universities, he said that because Denmark generally believes that gender equality has been achieved, free universities do not have gender bias, so there is no policy to promote gender equality in the Danish university

where he works. Expert 5, an expert in promoting education and reducing stereotypes in education, described career guidance policies that could be adopted in colleges and universities to promote gender equality in STEM, but did not respond to policies that it had implemented related to promoting gender equality. Expert 2, an expert in the study of diversity, inclusion, and equity in STEM fields, described his involvement in a project to advance women from the U.S. community college talent pool to college to study STEM. However, when referring to the policies implemented by the university to promote gender equality, he said that he had participated in and heard about many measures to promote gender equality in STEM fields, but the results were not great. Expert 4 is the draftsman and implementor of the University's Gender Equity Plan (GEP). It said the university was implementing several measures to promote gender equality, including gender-sensitive training and gender-inclusive career guidance. However, it is important to note that these measures are being implemented in the context of the EU Horizon programme, which requires higher education institutions to prepare a gender equality plan as a condition of applying for funding. When there is no such measure, there is no financial support. In the progress of gender equality plan, the difficulty to progress the gender equality plan is mentioned. As the professor in STEM fields especially the leader management in STEM fields doesn't care that much about the gender balance in STEM, it makes it even more difficult to implement. The solutions for the negative opinion concerned gender equality in STEM turns out doing it casually and without notice, like involved the gender equality training in the regular meeting. In this sense，it's still difficult to make a fundamental change on people's opinion on gender issue in STEM HE or HE in general.

5.2.3 Highly Contextualized and Multi-level Difficulty

Whether the gender gap in higher education is a structural problem or a personal problem is related to the choice of measures. An analysis of the experts' descriptions of gender equality issues in STEM shows that the experts agree that the influence of social stereotypes leads to the division of gender role paths. Although the expert initially disagreed with the gender bias in his higher education, he said there was no perception that women were weaker than men. But in its

recommendations on gender inequality in higher education, it argues that at the heart of the problem is social stereotypes that define girls as emotional and better suited to liberal arts majors, which hold them back. In addition, as higher education institutions and other administrative institutions are dominated by men, it is also a matter of concern that the existence of such a structure is not due to the ability of women, but the structural inertia of male hegemonic structure leads to the continuous support of men from other men in the process of rising, and it is proposed that the stage of gender equality has not yet been reached. The gender quote should be used to promote the optimization of the gender structure in higher education institutions, if not, such a gender structure will not change on its own. Expert 3 also has a positive attitude towards the adoption of gender quotas in higher education institutions and believes that it can be tried, also because the structural problems will not change on their own if nothing is done. In addition, she holds a negative view on the question of whether the guidance system should be implemented in colleges and universities, because she believes that the guidance system itself is based on the issue of gender equality in higher education is a human nature issue, and gender inequality in higher education is not a problem for girls, so guidance policies for girls should not be adopted. It directly expresses its view that gender issues in higher education are structural issues. Moreover, the policy suggestions put forward by expert 3 are to train teachers on gender equality and try to adopt gender quota methods. These methods are adopted to solve structural problems. Therefore, expert 3 believes that gender problems in STEM fields of higher education are structural problems. While Expert 2 did not directly state the nature of the problem in the STEM field of higher education, from her account, it is not entirely certain whether the problem is structural. For example, she emphasized that the current view is that female students do not like engineering majors. In the effect of the policies she observed, she found that the policies related to structural reform, such as the methods of curriculum reform, and many other methods are not effective, and raised her concern, reflecting her contradiction on whether gender equality in engineering majors can be changed through measures. Not only do we see the positive prospects depicted by the measures, but we also see that the status quo is difficult to change. At the policy level, she supports special

guidance for women in STEM fields, especially for women who are intersectionally disadvantaged, that is, racially disadvantaged and economically disadvantaged. For example, she said that she has actually implemented a lot of coaching behavior and believes that the effect is good. Mentoring individual minority girls is a human policy that provides support through individual help. The core of Expert 5's view is that reform should be carried out through an pedagogical approach and support the implementation of guidance systems. However, the guidance system she supports is a career guidance system based on gender equality training for teachers, rather than a means of empowerment for individual women. In fact, she also identifies problems in STEM fields as structural problems and proposes to influence structural changes through educational means. Expert 5 did not give a direct answer to the characteristics of gender issues in STEM, but from her narration, she emphasized the description of the negative attitude of society towards this issue, and the description of the measures taken by her STEM field to train power levels, administrators, and teachers on gender sensitivity. She is a supporter of the process of promoting gender equality by changing structural gender perceptions. Overall, gender issues in STEM fields in higher education are structural issues that receive more support. According to the opinions provided by the expert group, it can be found that gender equality issues in STEM fields are closely related to the context in which they are located. The first is the social nature of STEM issues, which cannot exist in isolation from society. As expert 2 said, although STEM sector reform has positive prospects, STEM sector reform cannot exist in isolation from society. Therefore, the author believes that a holistic policy is needed, linking the reform of the higher education sector, the social sector, the research sector, STEM institutions, etc., in order to achieve holistic change. Second, the issue of gender equality in STEM fields is not simply divided by stereotypes that boys are suited to science and girls are suited to liberal arts. From the details of the analysis, the degree of closeness between different majors and mathematics, the theoretical and practical bias of different majors, and the differences in mathematics and science results from the basic educational background of different countries (for example, the influence of another layer of concepts and practices that Chinese students are considered to be good in mathematics results in the different gender

structure of Chinese mathematics). The gender structure at different degree levels does not necessarily follow the increase in qualifications, the decrease in the proportion of female students (this is not the case in Italy), the differences in the disciplinary background and environmental background, all of which present different challenges for the treatment of STEM gender issues. Personal background also has an impact on the formation of the STEM gender landscape. For example, the different basic STEM training received by girls at different economic levels also has an impact on their future career choices.

In general, gender equality in STEM has multi-level characteristics and difficulties, at the level of different discipline departments, at the level of different academic qualifications, in the process of connecting with high school, and in different national backgrounds, and more detailed programs are needed to intervene under the plan.

The lack of gender equality institutions was also mentioned by several experts. The lack of a head of gender equality in higher education institutions has created a dilemma for the formulation, implementation and monitoring of policies. As one expert said, the implementation of the gender equality program is just the beginning, and such requirements have brought positive attention to gender equality in higher education. But such a policy will not be effective if such attention is not translated into practice, and if it does not respond to the practical requirements of practice. For the implementation of the policy, professional and specialized responsible personnel are responsible for the actual implementation of the policy and the monitoring and data collection during the implementation process, which is beneficial to the implementation of the corresponding policy according to the actual situation.

5.2.4 Long Run in Resolving

As it mentioned by expert 2 who work in the gender equality in STEM fields for about 10 years, she witnesses no different in the field of engineering with different kinds of policies taken. In this sense, a clear and expected vision for eliminating the gender stereotype influence and build a gender sensitive environment which focus on satisfying the need of different learners. In the long run of achieving gender equality, a structural method especially the methods have the

potential to induce a change in the system can induce long run possibility. With the long run in resolving the gender inequality problems, some experts also suggested to consider a gender quote policy to push the gender equality process forward before the gender equality achieved.

5.2.5 Women in Multiple Vulnerabilities are Harder to Advance

What attracted the expert's attention is also the women in multiple vulnerabilities. As is mentioned by expert 2, when we talk about women in gender, what we should pay attention to are the women in poor families, with disabilities, as ethnic minorities violence, labour exploitation and gangmastering. A review recently revealed that the Athena Swan Charter recognizes and supports efforts to advance women's careers in STEM, but results in a narrow definition of equity and inclusion that disproportionately benefits white, middle-class women, and failing to address the impact of other aspects of identity - such as race, disability, sexual orientation, and socioeconomic status - on the system in which we live (Graves et al., 2022; Jebsen et al.,2022; Kalwant & Holly 2021). But from the policies, the attention to the vulnerable women is still limited, more researched should be done to recognize the need and difficulties of women in burnabilities, and published more specific policies which can have a long effect with a sufficient framework.

5.3 Policy Observations: from National, Institutional and Individual Perspective

Figure 10. Promoting Gender Equality in STEM HE in and through Gender-inclusive Education
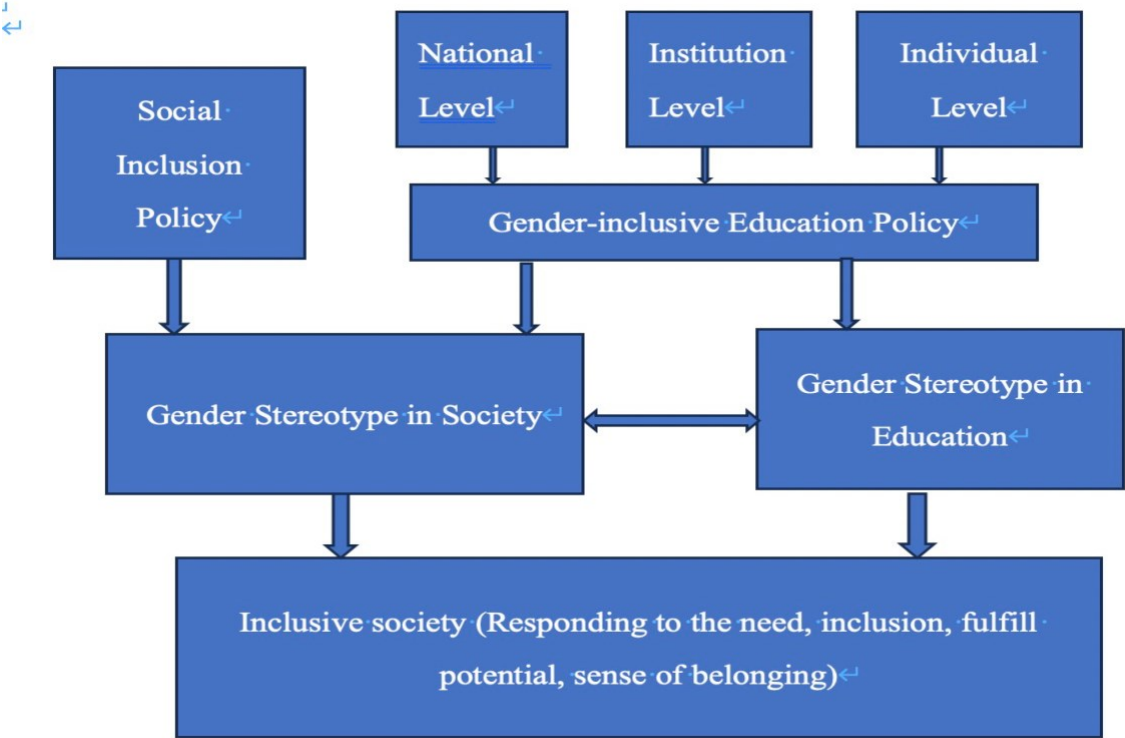
5.3.1 Policy Observations from National Perspective

Gender inequality is embedded in virtually all state and social structures, and producing meaningful structural reform effects requires the support of national policies. Policy focus should be put from the educational perspective. As a social problem which reflecting on the gender stereotype of people towards gender role professions, the potential of education to eliminating the gender conscious influence through. Firstly, with regard to gender equality in higher education, the vision of gender-inclusive and quality education should be articulated in the educational policy. The vision of gender-inclusive and quality education should focus on eliminating the gender stereotype obstacles, through a whole structural gender-inclusive change of the education system, to bring a gender-inclusive environment that people feel belonging,

and they all have the potential to do any kinds of work. When it turns to the hole policies system, the policies should be coherence with each other that, hole the same value about bring gender equality in and through education from all the education levels. As the policies being analysis in this thesis, In Italy, it shows an inconherence between policies. For example, in the policy for promoting lifelong guidance, the gender perspective is missing. However, guidance policies concerned identify potential and have an important influence in the process of choosing professional fields. And it's a potential interference stage. However, the missing of gender in country guidance policy showed an ignorance of gender perspective in the guidance. So a gender sensitive training for teachers. Helping students to mitigate the social impact of gender stereotypes in choosing a major is promising. At the same time, gender is not taken seriously in science literacy promotion programs. Now Italy is investing in STEM literacy for a new generation of students, including STEM training courses offered in primary and secondary schools. This is helpful in increasing the science literacy of all students. Through the cultivation of STEM science literacy, men and women also increase their understanding and interest in science. In this stage of teaching, how to make teaching more gender inclusive is promising for the cultivation of girls' scientific literacy and scientific interest. This refers to the prospect of integrating gender-inclusive education into STEM literacy training. In particular, gender sensitivity training for STEM teachers should be mentioned by helping teachers identify gender stereotypes that may exist in their teaching behavior and integrating gender inclusion into their teaching. In addition, universities are absent from the gender equality education policy. In the gender equality education policy, directions are specified on how to carry out gender equality education in primary and secondary schools, but there is no mention of the university part, which indirectly reflects the neglect of gender equality education at the university stage and the construction of gender inclusive, equal and quality education environment in universities. Vision of a policy is the direction and place where the policy is about to arrive. A clear vision of a policy plays an important role in realizing the purpose of the policy. Moreover, the issue of gender equality in STEM fields is an issue rooted in social stereotypes, and its change is closely linked to social change, and its change requires a longer cycle, and a clear vision is meaningful

for issues that require long-term change. In both Italy and China, there is a clear vision of a human rights orientation in policies, including the promotion of gender equality and the development of human potential, but such a vision is not closely linked to education.

Secondly, at the level of implementation of specific measures, gender equality and education should be integrated, and gender equality and inclusive education should be integrated into education policies and into all policy areas, which is an important factor in the generation of structural change. Just as Expert 3 mentioned the mandatory gender inclusive training for university teachers, Expert 4 mentioned the gender-sensitive language training for university administrators being implemented by his university, the gender-sensitive administrative organization training, especially the gender-sensitive training for university leaders, and the training for the implementation of gender-sensitive teaching for university teachers. However, it is worth noting that in order to avoid the appearance of policy formulation, at the level of policy implementation, the implementation of gender equality policy in higher education, as mentioned by experts 3 and 4, should be set up a special agency responsible for the implementation of gender equality policy. This specialized agency is responsible for the collection and implementation of data. Institutions responsible for gender equality and inclusion should be established. Fifth, from the national level, appropriate funds should be set up to promote universities to set up corresponding institutions at all levels, which should not only be at the university level, but also embedded in each college and department. For Italy, universities across Europe have embarked on a journey of change, driven by the GEP, the European Union's gender equality program me, in order to obtain the corresponding gender equality fund. Therefore, at the level of the implementation of the gender equality plan, it is more necessary to identify institutions and take responsibility for the implementation. If a school has only one organization responsible for the development of the plan to obtain funds, the implementation process may be different, or stakeholders may not be able to participate in it, and gender equality action cannot be deeply embedded in the grassroots institutions. Then the effect of policy formulation and implementation will not be very ideal.

Thirdly, closing loopholes for vulnerable populations. Women has always been viewed as a

vulnerable group, but for women with more vulnerable features, it's even more difficult for them to break the gender role barriers before them. Whatever the research, statistic collection and policies making should including gender as a perspective.

Fourthly, there is a need for a complete framework to ensure the implementation of gender equality policies. Policies on gender equality in STEM in Italy exist in the literature of The National Strategy for Gender Equality 2021-2026 (Policy 6), National Recovery and Resilience Plan in Italy (PNRR) (Policy 7), Woman for a New Renaissance (2020) (Policy 8), Guidelines for Guidance 2022 (Policy 9), Guidelines for the Gender Budget in Italian Universities (Policy 10), National Guidelines (art. 1 paragraph 16 l. 107/2015) Education Respecting Gender Equality, the Prevention of Gender Violence and All Forms of Discrimination, etc. However, there is a lack of a complete early intervention to gender stereotypes for gender equality in STEM. There are comprehensive policies on gender equality education and education guidance at all stages of education, but the higher education period had been neglected and the intervention of inclusive and quality education environment, construction of gender equality environment in specific professional fields, intervention of gender equality in research or work environment after graduation, and higher education has been neglected in policies. The framework for eliminating gender stereotype is failed to include the government, private education institution, private company and all level of education institution together to form a comprehensive inclusive environment. Structural changes rooted in gender stereotyped roles need to be promoted by a structural framework, and scattered regulations cannot produce structural changes. Lack of education for gender equality in higher education, educational guidance policies for higher education that exclude gender stereotypes, and policy provisions for reducing the impact of stereotypes in higher education should be the prima focus of Italian HE policies transformation. China's policy on the development of female scientific and technological talents essentially involves all aspects of the training and development of female STEM talents, including the gender equality in all levels of education, policies of gender equality organizations at all levels, and the promulgation of local science and technology department policies, but the reform policy of gender structure of HE institutions is still missing.

The gender equality transformation in HE is based on individual transformation which focused on the education and financial support to women in STEM in HE in China, the transformation through an education way is missing, the change from a structural way in total has not been focused.

Moreover, when taking measures, data should be the basic support. Gender equality issues in STEM higher education are complex and multi-layered. In the expert interview, expert 2 and expert 3 both have relevant statements. Expert 2 believes that gender equality in STEM higher education has different characteristics in different professional fields, different educational fields and different national backgrounds. Expert 3 also believes that gender segregation in each field is different, and research should be conducted according to each subfield and corresponding measures should be taken. The data analysis in the field of STEM higher education based on majors, degrees and years also proves that gender segregation in different countries is different in different subject fields. For example, due to the certain advantages of mathematics exam-oriented education in the basic education stage before higher education in China, Chinese students have good math scores, and the gap between men and women in Chinese colleges and universities is smaller. There are more girls than boys in mathematics and applied mathematics, while in Italy the gender gap in mathematics and related subjects in higher education is small and almost equal, but there are more boys than girls, and the gender gap is slightly increasing. In Italy, there is a reverse gender segregation in the biological sciences and related majors, with women accounting for 70% or more of the total number of students. The gender gap in both Italy and China is evident in engineering and ICT majors. Therefore, in the face of the complexity of gender equality issues in STEM higher education, clear data is needed for the title, and structural changes need to incorporate gender issues into all levels related to gender equality. First of all, we need to collect comprehensive data on the educational opportunities, educational process and employment outcomes of students at all levels of STEM majors. On the basis of data collection, it is necessary to clarify the manifestations and gender needs of problems existing in various majors and education levels. Only based on open and detailed data can the analysis of problems be fully based. It is worth noting that in front of Italy's

policy proposals, there will be a large space to describe the existing problems and related data support, relevant theories, literature support and specific goals, which will serve as the basis for policy formulation and make the introduction of policies more realistic. There is no such argument in China's policy announcement.

5.3.2 Policy Observations from Institutional Perspective

At the university level, the application of the school's subjective initiative to solve problems often produces twice the result with half the effort. And many of the problems actually exist at the university level, but many schools don't realize it. Institutions of higher education are themselves gendered institutions that largely serve to repeat patterns of gender inequality. Universities are also important institutions that directly train and guide STEM women and directly contact and manage them. Therefore, it is of certain significance for universities or even each college or discipline to take measures independently to bring about certain changes. As pointed out by expert 3, policies can only play a limited role. At the level of higher education institutions, how to take certain measures to promote the construction of gender equality environment is very critical. Through STEM graduate communities, including STEM student communities, and STEM professional groups, to take certain measures to ensure that female students in this field have the power of change. And through the establishment of gender inclusive environment in the institution to produce corresponding changes. Data should be collected on the participation of girls in school, not only on gender equality in the enrolment of girls, but also on the performance of girls in higher education institutions and their overall performance in school, using gender as an indicator. And a follow-up report on women's jobs after graduation. Gender stereotypes are with us throughout our lives, and being in an environment of gender inequality at any stage is a limit to the potential of each individual. So we should focus on the transformative measures that are being taken in higher education institutions, such as the curriculum of interdisciplinary education, such as the integration of gender-sensitive pedagogy into the educational process in the structure of higher education. The CRUI Gender Commission points out the desirability of requesting access to European funds

to allow university institutions to provide themselves with the dedicated human and financial resources required.

5.3.3 Policy Observations from Individual Perspective

Because STEM gender equality is a structural problem, many experts have repeatedly mentioned that girls are not the problem, but the guidance and attention to the development and orientation of women may also be a good way to help the problem develop in a good direction. Specific counselling and support for female students is essential to directly address the problems faced by girls and to address the needs of girls in a sustainable manner. As described by experts 4 from a higher education institution in Slovakia, they take such a positioning approach through the need to receive guidance in positioning. With the identify of need which can be more target. But as what kind of way of guidance can be more efficacy is lack of knowledge. As is described by one professor, they tried to bring gender equality in the process of guiding which is supposed to build a gender inclusive environment in STEM university. There are a lot of way to conduct, and the research concerned effectiveness of guidance remain promoted. Expert 5 also pointed out that mentoring is a worthwhile investment. However, it should be noted that guidance should not only be for girls, but should be for all students, gender stereotypes are rooted in men and women, and policies targeting only women are not holistic, and women cannot exist apart from society. Attention should be paid to reducing stereotyped guidance in education and guidance, starting with investment in gender-sensitive training for teachers. But in the individual perspective, it's crucial to pay attention to the female student who is in more vulnerable situation who need more support. With the broad aim of the policies, the specific need will be missing, so when focused on the individual perspective. The different background of female which can be more vulnerable need attention.

5.4 Research Progress and Limitation

Based on the education right theoretical framework, this dissertation conducted through an examination of policies concerned gender equality in STEM in higher education and expert

interview on how to eliminate the influence of gender bias and build a gender inclusive environment for achieving everyone's potential. It points out that there is not much that can be done from an equality perspective other than study choice guidance, which means that when it comes to developing policies for equal participation of different disciplines in higher education, educational policy goals should not be entirely market oriented (De Wit & Bekers, 2020). This paper argues that the gender gap in STEM fields reflects the influence of social stereotypes on women's choice of career and reflects the constant influence of gender roles on the realization of women's potential, so it should be determined by examining whether education is sufficient to remove the obstacles of social stereotypes to promote the development of potential. Education has the potential to change stereotypes, education is a human right, and the realization of women's right to education is related to whether the obstacles of gender stereotypes can be effectively overcome in education and through education (Bohan, 2014). Policy is the compass of practice. Through the study of education policy, we can clarify the direction of policy and the gap between them (Owen, 2014). Equality in STEM fields, Inclusive and quality education contributes to the realization of women's equal right to education (National Research Council, 2011; Engida, 2021). As mentioned in the United Nations Sustainable Development Plan and the United Nations Education for Everyone, to meet the ambitious aims posed at national and European levels, a "pedagogical perspective" must be adopted to view the gender (in)equality question and proposals (Agenda 2030; UNESCO,2010; 2012). This paper analyzed policies related to gender equality in STEM in higher education, guided by the right to Education framework and the inclusive, equitable Quality Education framework. In the first section of Chapter 5, I critically analyzed the progress and gaps in the realization of women's Right to Education in Italy and China through the education equality and inclusion theory. Moreover, by comparing the implementation of the STEM gender equality higher education policies of Italy and China to the requirements of the United Nations International Convention on the States parties, it is found that the policies of Italy and China are not perfect enough to promote the construction of gender inclusive environment in higher education. It compensates for the lack of research literature on critical analysis of gender

equality policies in higher education and expands the knowledge of gender equality policies in higher education. In Italy's policy to promote gender equality in education, the level of higher education has not been paid attention to, and there is a lack of gender inclusion in higher education. There is no focus on reducing the impact of gender stereotypes in the documents that guide students' career directions. The promotion of gender equality from the perspective of teaching has not attracted enough attention. Although gender equality education in higher education is stipulated in China's women's development policy, gender equality in education is not mentioned in the document of China's education modernization, which has guiding significance for education. This reflects that gender equality in education has not received attention from the education department. Whether it can effectively carry out gender-sensitive actions at various levels such as educational materials, teacher training and teacher teaching in the implementation process has been questioned.

This study paid specially attention about if and what guidance should be given to young people in choosing subjects, study, further study, and careers (De Wit & Bekers, 2020; Bohan, 2014; Bothwell et al., 2022a). The guidance is pay attention since Article 80 d) of Beijing Declaration and Platform for Action calls upon Governments to take measures to establish decision-making Gender-sensitive professional learning counselling and vocational education programmes encourage girls to take academic and technical courses to broaden their future career opportunities. From the policy analysis and expert interview, it pointed out a investment prospect for orientation to help students eliminate the influence from the society and form a free way to seize the direction they want as their career.

This study is focused on the policy document itself and in theory of experts. The action part of the policy in higher education institution is missing. It can be a promising project to do some case study in terms of best practice universities to get a further information about how the gender equality policy is exactly conducted in the higher education institution. And concerned the student guiding in the universities, more study needed to conduct through field work to recognized what kind of guidance can be productive.

CONCLUSION AND PROSPECT

SDG goals 4 and 5 appeal for the promotion of inclusive and equitable quality education and to achieve gender equality and empowerment of all women and girls. However, progress on the implementation of gender-inclusivity in higher education (HE) and on inclusive education approaches in the design, implementation, monitoring, and evaluation of education policies is yet to be explored. This thesis has presented the results of this exploratory and explanatory research into the progress and direction of policies for promoting gender inclusive and equitable STEM higher education, aimed overall at greater global inclusivity.

With the current paucity of comparative research on STEM gender inclusion on Italy and China, this thesis conducted a comparison of policies promoting gender equality in HE in these two contexts. Representative of Eastern and Western cultures, comparison thereof further promotes gender inclusion, equality, and expansion in the quality educational policy direction and content . Through analysis of specific policies, it was found that policy orientation in promoting gender equality in STEM higher education in Italy is geared towards structural reform. With the European Union's (EU) stipulation demand of a university gender equality plan to secure funding, a structural change plan has been constructed by all universities. Italy's national policy direction is accomplished through interdisciplinary education and innovative teaching methods. This promotes the progress of gender equality in universities by ensuring the gender structure of HE institutions is a condition for the application of additional funding. However, the gender sensitive dimension in promoting basic STEM education aimed at promoting future-oriented scientific literacy, has not received any attention. Moreover, the promotion of gender-sensitive student guidance orientation and its implementation at HE level is absent, which is insufficient. Finally, lack of focus on gender-sensitive teacher training, and the inclusion of gender perspectives in national fund applications is limited to structural equality awards.

In China's HE STEM policies in relation to women's development overall and in science and technology, a relatively complete gender equality education and vocational guidance education framework are evident. However, no guidance exists from a gender equality perspective in its

main national education policies, reflecting a neglect in promoting gender equality through education. China's policies encourage scientific research among female college students and their participation in international exchanges, and female scientists focus on the discovery and training of outstanding female talents. Chinese policies tend therefore favour this talent cultivation in both science and engineering alongside conducting this reform through individual female students rather than structural university plans. There are however, limited institutions and administrators responsible for the implementation and monitoring of gender equality therein, as well as an absence of publicly available gender data on enrolment, attendance, and employment in various HE disciplines. Finally, China's plan for institution-wide gender equality structural change is also insufficient.

Gender inequality in HE STEM originates from gender stereotypes embedded in society. With the progress of gender equality and empowerment of women's rights, different progress is evident in each of the STEM disciplines. To promote inclusivity in the STEM fields, education is being urged to construct of gender-inclusive environment as a minimum. In addition, a needs analysis of each professional level is essential in the first instance. Then measures should be undertaken at national country, higher education institutions and individual levels. Progress in and promotion of gender equality within this specific context can only be achieved through the connected efforts society, active promotion of policies and industry demand, the higher education institutions, and the efforts of female teachers or students; each aspect plays a fundamental role. The persistence of gender equality in STEM fields requires a structured approach to change, with the role of educational change fully leveraged to continue promoting inclusive, equal quality education, and social environment policy directions that works towards developing individuals' potential and ensuring their well-being. Moreover, as gender segregation in HE is a global issue, this paper has analysed the views of experts in concluding that the process of gender equality in HE is insufficient. A gender sensitive HE approach to making a difference in and through education still holds the potential for change. Moreover, with complex and differing situations in STEM disciplines, action is required at departmental level in HE.

While this comparative research has combined both theory and practice, it explores only the tip of the iceberg when it comes to offering a comprehensive response to gender equality in STEM in the chosen context. Future research should deepen the comparison between China and Italy, by, for example, a more practical qualitative analysis, comparing specific cases of gender equality promotion in Chinese and Italian universities from individual student, researcher and professor levels. As for the role of teaching methods in promoting gender equality, gender-sensitive teacher training and time-sensitive research on integrating gender perspectives into teaching are required. Research on innovative teaching methods for promoting gender equality in STEM should also be enhanced, alongside more effective methods in ensuring better cooperation between HE and K12, to facilitate the elimination of gender stereotypes of undergraduate majors and professions. This research has focused specifically on a STEM context, however, gender segregation among male students in liberal arts like education and caring also deserves attention. Moreover, beyond research on eliminating gender stereotypes and promoting radical gender ratio change in STEM HE, difficulties encountered by women in the STEM work context requires researching. Encouraging women to enter STEM fields further requires supporting their needs in the workplace and responding to the difficulties they face, including work-life balance, economic recognition of caregiver burden, and educational and care services for children and the elderly; these aspects also contribute to the gradual departure of women from STEM fields. The issue of gender equality in STEM HE does not exist in isolation, and a holistic cooperative approach by all parties is needed.

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