



**A DIGItal toolkit for promoting gender EQUALITY  
in science and technology**

**Methodological Guide  
Part I**

**GENDER EQUALITY in STEM**



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## Table of content

Introduction.....	3
DIGI4EQUALITY project .....	4
Current females' education in STEM.....	6
Description .....	6
1. Key factors perpetuating gender STEM gaps. ....	7
2. Which bias do women have to face nowadays in STEM education? .....	8
3. How all the aforementioned barriers lead to the psychological belief that one can't -or is better not to- follow a career in STEM.....	12
4. What can we do in order to overcome these issues? .....	12
Conclusion .....	15
Bibliography.....	16

## GENDER EQUALITY in STEM

*“Even today, in the 21st century, women and girls are being sidelined in science-related fields due to their gender. Women need to know that they have a place in science, technology, engineering and mathematics, and that they have a right to share in scientific progress.”*

*Audrey Azoulay, UNESCO Director-General*

## Introduction

Despite the vast progress humanity has achieved in numerous areas, gender equality is yet to be accomplished. Various researches prove that women are still undermined, undervalued and mistreated in all areas of interest.

The goal of this project is to encourage young girls to deal with STEM educational and vocational possibilities with greater openness. According to the initial survey, we conducted in our schools regarding famous women, we discovered that 87% of students aged 11-15 cannot recall more than 2 famous ladies in the areas of science, literature and politics. Moreover, only 54% of them, could list 3 famous women in popular areas such as film, sport and literature, when 89% could enumerate 3 or more girls connected with fashion and bloggers, a field highly related with women in most peoples' conscience.

The aforementioned results created a vast need to organize a multinational group to work on a project related to the integration of women and girls, marginalized from the STEM field. Our purpose is to offer a set of inspiring tools which could encourage and support girls to participate actively in the STEM field.

The project addresses an important problem, the lack of female role-models in Science, Technology, Engineering, and Mathematics. This fact thereby leads to low self-esteem for girls and women who fail see their counterparts in related areas and consequently lack the inspiration to achieve in their grounds.

This project aims to tackle the problem of gender stereotypes in societal and occupational choices in the modern digitalized world. Moreover, it will raise awareness against such biases and highlight famous women to look up to in this area. Additionally, it is crucial, to create a toolkit which will help strengthen girls' aptitude in the pursuit of a career in STEM and encourage them to believe in their potential.

## DIGI4EQUALITY project

**DIGI4EQUALITY** stands for “A DIGital toolkit for promoting gender EQUALITY in science and technology” (Reference Number **2020-1-PL01-KA201-081630**) which is a project in the framework of **Erasmus+ programme** under the Key Action 2: **KA201 - Strategic Partnerships for school education**. DIGI4EQUALITY project will be developed during 24 months from 01-10-2020 to 30-09-2022.

The **consortium** is comprised of 5 countries: **Poland, Greece, Italy** and **Latvia** are ranked in lower positions than the EU’s score on the Gender Equality Index 2019. It is important to mention that **Turkey**, the 5th partner, which is ranked 130th out of 153 countries in the World Economic Forum's (WEF) Global Gender Gap Index 2020. All these imply that much more need to be done in terms of closing the gap in gender equality. More specifically, the project partners are:

1. SZKOLA PODSTAWOWA NR 2 W PROSZOWICACH, (Poland)
2. E-SCHOOL EDUCATIONAL GROUP, (Greece)
3. CHALLEDU, (Greece)
4. EURO-NET, (Italy)
5. AYDIN IL MILLI EGITIM MUDURLUGU, (Turkey)
6. ADAZU VIDUSSKOLA, (Latvia)

The **aim** of DIGI4EQUALITY project is concerned with developing a novel toolbox by which professionals can attract, reach out and assist students to raise awareness and tackle gender stereotypes in society and in occupational choices in a digitalized world.

To achieve this aim, the DIGI4EQUALITY project targets to:

- ✓ highlight the important role of women in science and technology

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- ✓ ensure a gender-transformative environment for girls and boys to overcome gender stereotypes with regard to roles of women and men at work and in society
- ✓ encourage both girls and boys to make career choices in a digitalised world
- ✓ raise teachers' awareness on gender equality, regarding their interactions with boys and girls
- ✓ strengthen educational skills when coping with gender equality.

The project is addressed to the following **target groups**:

1. girl students as the created material will have a positive impact on their aspirations and self-confidence about their role in STEM and society and for potential career choices,
2. boy students as they will develop positive attitudes toward gender equality,
3. teachers, STEM educators, school mentors and counsellors that can promote a learning environment in schools that is free from gender discrimination and
4. parents, trainers, career counsellors, career coaches, researchers, science communicators, game designers, volunteers and other professionals and in general the local and European community as gender equality is essential to achieve sustainable development of societies.

Through the DIGI4EQUALITY project the following **results** are expected:

- A methodological guide to promote gender equality in STEM in schools taking into consideration the impact of the recent socio-economic changes brought by the rapid spread of digital technology in the world and the need for integration of women in STEM and society.
- The e-learning platform which will be a valuable resource for teachers to achieve gender equality and girls' empowerment not only in STEM education

but also in society. The possibility of enriching the platform with more material created after the project completion will be open.

## Current females' education in STEM

### Description

The list of famous math, science and engineering researchers throughout the history is highly male-dominated; Aristotle, Galileo, Newton and many more, in opposition to women who starting entering this list in the late 19<sup>th</sup> and the early 20<sup>th</sup> century. Moving forward to computing and information technology, this stereotype continues to exist, given that the most famous innovations in this area were accomplished by males. Subsequently, it is no surprise that people associate STEM fields of work and education with men.

Regardless the significant improvements in the recent years, education is still not equally available for men and women and gender disparities continue to insist. Over the past decades, researchers from different fields have conducted numerous surveys trying to figure out why women are underrepresented in STEM education and vocations. Interestingly enough, even though women attain good equal grades to men in STEM lessons, they still turn away, or they are pushed away from STEM fields.

It is certain that the educational system demonstrates a crucial role in the determination of a student's (a girl's in this case) interest in particular subjects, as well as in providing equal opportunities and benefits for quality education in STEM subjects (science, technology, engineering and mathematics). A country's Educational System is a product of long processes that are strongly related to environmental, social, economic, cultural and gender norms. These stereotypes influence the way girls or boys play, interact, study, behave and make choices from an early stage in life. But these choices are not made irrespectively to the immediate family or social

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environment. They are the result of multitude factors, varying from social, cultural and gender stereotypes, which affect the way children are brought up (Irina Bokova, 2017).

### 1. Key factors perpetuating gender STEM gaps.

New research finds indicate that women simply feel like they don't belong in the fields of STEM. This comes as the result of various reasons proving that the roots of this problem begin very early in life, during childhood.

According to the theory of the neuroplasticity of the brain, the kids are able to absorb external influences stronger until the age of 12 years old. Moreover, until the age of 6, the child's brain is stabilized, meaning that all the outer stimuli received until that very age, are becoming more permanent. All these facts prove that by the time a girl enrolls to elementary school, she is already strongly influenced by the immediate family environment. According to the biases of this environment, she is already prejudiced against the treatment, she will receive from her teachers and the other kids in the classroom. She has also set-in mind her parent's expectations, regarding her grades, her behavior and her attendance in general (Irina Bokova, 2017).

As long as the family environment is concerned, evidence shows that the parents' beliefs, expectations and attitudes against their children are influenced by gender bias and they are the main reason behind the fact that they treat differently their daughters and their sons. Their bias is influenced by social and economic reasons, by the family they were raised in and by their overall educational and vocational experience. That explains why families with higher economic and social status as well as high educational qualifications tend to provoke their daughters to follow STEM education as opposed to families with lower income, lower socio-economic status and belonging to minorities. Therefore, it is not easy to separate biological ability reasons to cultural influences (Irina Bokova, 2017).

These are the most common factors that lead to gender STEM gaps. Firstly, when it comes to **school**, girls are brought up with the idea that they cannot perform as well as boys in the STEM fields. Therefore, they shape their minds to believe that they will never be quite good enough to compete with them in these subjects. Subsequently, due to fact that only few women choose to study and work in STEM, these **fields are Male-Dominated** and therefore unsupportive and exclusionary of women. This way, Male-Dominated Cultures are formed in many of these fields (Christianne Corbett, 2015). Additionally, there are very **few role-models** for girls to look up to. The majority of teacher, professors and professional in the field of STEM are males, so girls have limited examples of females to inspire them. Lastly, a very important fact is the math anxiety of female teachers pass down to their female students, only due to their own prejudices towards themselves (Irina Bokova, 2017).

Another issue that is receiving increased attention lately is the fact that many students interested in pursuing a science, technology, engineering or mathematics field during their post-secondary career, ultimately do not earn a major in one of these fields. In particular, female and minority students are less likely to enter college intending to major in a STEM field major, but if they do so, are more likely to switch away from their initial choice. Regarding this are of interest, there is some evidence that role models could play an important part in the college major choice decision as well. Research indicates that female students are more likely to persist in a STEM major if the institution there are studying in has a high percentage of female STEM graduates. Consequently, it becomes clear that as the graduate student population in STEM fields becomes more female or minority, so does the undergraduate major population (L.Griffith, 2010).

## 2. Which bias do women have to face nowadays in STEM education?

According to UNICEF, investing in women is equal to investing in the future of humanity, since girls can transform communities, nations, countries and the whole

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wide world. When investing in a girl's education equally as a boy, it contributes to equivalent, stable and resilient societies. (UNICEF, 2020).

Continuous outcomes of modern research in biological reasons behind the gender gap in STEM education indicate that the gender doesn't have a role in educational performance. On the contrary, the main reasons why any girl (or student in general) may lack in good performance in particular subjects is the age and the depth of engagement. With specific and targeted interventions, all students of the same background will achieve the same level of excellence. Therefore, since it is scientifically proven that women do achieve the same level of scores and abilities in STEM related subjects as men, the reasons behind their discrimination must be explored in different pathways (Irina Bokova, 2017).

Modern beliefs regarding gender equality emphasize that the concept of freedom in private life and the connection of the concept of democracy with the family. Therefore, the improvement of the position of women in public life can be achieved only by the application of equality in the private sphere and democracy in the family.

### Barriers related to the Educational System

Women and girls still face multilateral discrimination, direct or indirect, in many aspects and stages of their educational path. Interestingly so, these seem to deteriorate when climbing from one educational level to another, from primary to secondary school and higher education.

A girl's education is much more than just access to school. Even though the number of young boys and girls who receive education tends to be equal, in most cases, they are **not equally treated** (Christianne Corbett, 2015).

Another major barrier for women in STEM field, is **lack of confidence**. STEM choices in most cases are rather related to one's belief of their educational ability rather than the actual ability. Psychological studies indicate that the idea that math is a male-

lesson can be quite self-fulfilling and trigger boys' growth mindset. According to another research, a math growth mindset is closely related to math performance, interest and course taking in middle and high school. Additionally, two similar experiments based on middle school students showed that when female students were equally introduced to math growth mindset, they performed the same or even better than male students. All of the above underline the importance of consistent and equal inducement and stimulus to all students, regardless their sex in order to achieve equality in STEM fields (Shulamit Kahn, 2017).

### Barriers related to Social and Cultural Factors

The wider family plays an important role in shaping a girl's attitude towards STEM. Parents or other members of the family may portray their beliefs and expectations in young girls. These beliefs are influenced by the educational level, socioeconomic reasons and other norms. As aforementioned, parents with higher socio-economic status and educational level tend to have more positive attitudes towards STEM education for girls and the corresponding vocational paths, compared to parents with little to no education and significantly lower income. Also, people belonging to minorities may prevent their daughters from entering an educational or vocational space, in which they will be handled with discrimination.

All of these barriers become more obvious during adolescence, when gender roles are clearer and gender discrimination is more conspicuous. In many countries of this world young women have to face early marriage, taking care of the household and prioritization of boys' education. Moreover, safety factors are a very real barrier, especially in rural or disadvantaged areas (Irina Bokova, 2017).

According to UNICEF, around 44% of adolescent girls in the poorest countries of this world drop out of school or have never actually attended school (UNICEF, 2020).

According to research, the gender gap is significantly larger towards mathematics and mathematically-related jobs in advanced industrial societies. Girls like math less, related to boys, in more affluent societies. This also stands for individual mathematical ability, social class background, curricular difficulty, and many more factors. But how are we led to this outcome?

Maria Charles from University of California-Santa Barbara in National Science Foundation (2020) explains:

*'Cross-societal differences in the attitudinal gender gap, partly reflect different cultural beliefs about gender and about the nature and purpose of educational and occupational pursuits. In societies with broad-based material security and highly individualistic cultures, students are encouraged to follow their passions and choose career paths that will allow them to express their "true selves". Self-realization through education and work is a culturally legitimate goal. But understandings of who we are, what we will enjoy doing, and what we will be good at are influenced by culture, including widely-held beliefs about gender difference.'*

She also points out that *'adolescence is a crucial time for students to imagine a range of possibilities for their future study and work--and a time when these choices are often narrowed unnecessarily. Research suggests that adolescents are the group most reluctant to transgress cultural gender norms and most influenced by stereotypes about what they're good at and what they will enjoy. Most people don't really know what they're going to like until they do it'*. This emphasizes the need to create a supportive environment for girls and women, one which will urge them to get engaged in STEM educational and career path more willingly (Yan Ling Anne Wong, 2020).

3. How all the aforementioned barriers lead to the psychological belief that one can't -or is better not to- follow a career in STEM.

### The Stereotype Threat

The 'stereotype threat', is a phenomenon which describes the anxiety one encounters when being judged contingent on a group-based stereotype. It has seriously negative effects, such as physiological stress responses, a faster heart rate, increased cortisol levels, skin conductance and negative thoughts or feelings. All of the aforementioned symptoms are proved to decrease memory capacity and math performance as well as interest and motivation for women among the fields of STEM (Christianne Corbett, 2015).

Existing patterns of occupational sex segregation and the gender stereotypes surrounding many STEM fields insure that many girls and women never consider these fields. Scientific and technical work is often portrayed as solitary and isolated, populated by nerds and geeks--certainly not where culturally feminine aptitudes and affinities will be appreciated or put to good use. Girls often point out that they do not want to follow paths in math, technical issues or IT because girls who do, are much less attractive in the traditional feminine way (Yan Ling Anne Wong, 2020).

### **4. What can we do in order to overcome these issues?**

Girls disadvantage in education isn't related to their cognitive ability, rather than the social and educational patterns there are raised with, which reflect on their beliefs, their identity, their reactions and their choices. Since STEM sciences play a crucial role towards the achievement of 2030 Agenda for Sustainable Development, it is of great importance to include women in this breakthrough (Christianne Corbett, 2015).

The first step we can take towards this direction is to acknowledge the fact that all of us, with any exception, are affected by gender stereotypes, whether we are conscious

about our discrimination actions or not. In order for progress to exist, it requires **holistic and integrated approaches** (Christianne Corbett, 2015).

In order to move towards gender equality in STEM fields, the following initiatives can be taken:

- 1. Sensitisation to gender in teacher training** could help avoid perpetuating gender stereotypes while raising teaching standards across the board (Marcus, 2020). This way, teachers will be better aware of their interactions with their students, demonstrating equal intergration of male and female students to STEM lessons (ExtendEd Notes, 2017).
- 2. Providing Female Role Models.** When asking students to imagine their science teachers, it is most possibly that they will describe a man instead of a woman (NCG project: National Girls Collaborative , 2020). This ideal reflects on their educational and career choices, drawing them further away from STEM fields. Female role models are proved to help strengthen young women attitude and self-respecting towards STEM lessons as well as to consider the field of STEM as a viable career option (Christianne Corbett, 2015). Therefore, it is of high significance to provide young girls with the rightful role models to look up to.
- 3. Educational outreach at all Grade Levels (K-12 schools & college).** It is important to spark girls' interest and participation in STEM from an early stage of education. These actions could include events, workshops, themed clubs etc., that will offer hands-on experience on the field for all female students (ExtendEd Notes, 2017).
- 4. Use of fair learning materials.** Ensure that all educational material used during the lesson isn't promoting gender bias or discrimination. A lot of visual material in different text books present females in traditionally male jobs, which slowly but surely changes the perspective.



Standard English text book popular in Polish secondary schools; "Repetitorium, 2016, MacmillanEducation

5. **Up-to-date educational approaches.** Research must invest in new ways to foster students' skills such as critical thinking, problem-solving, mathematics and science literacy as well as digital skills (Marcus, 2020). Girl-centered programming, collaborative learning and opportunities of mutual interaction and learning could help significantly towards the concept of equality between male and female students (Karen Peterson, 2020).
6. Offer **career-orientation events** for students and their parents. In these events teachers will inform the parents about current trends and career opportunities of the future. They will also provide information about the importance of digital skills and other qualifications for the future working environment.
7. **The sense of belonging.** Gender biases also influence the way we perceive ourselves and our future preferences. The sense of belonging can have very positive effects for students, since according to studies, they could manage their daily tasks in a better manner, improve their academic attitude and lessen their worries (Christianne Corbett, 2015).

## Conclusion

The list of famous math, science and engineering researchers throughout the history is highly male-dominated; Aristotle, Galileo, Newton and many more, in opposition to women who starting entering this list in the late 19<sup>th</sup> and the early 20<sup>th</sup> century. Moving forward to computing and information technology, this stereotype continues to exist, given that the most famous innovations in this area were accomplished by males. Subsequently, it is no surprise that people associate STEM fields of work and education with men.

All of the facts and issues mentioned in the research above, underline the need to create a more inclusive, supportive and integrative environment for all young girls and women in Science, Technology, Engineering and Mathematics. Despite the progress humanity has achieved in the modern era, gender disparities continue to exist. The interesting detail here, is that they are not distinct only in countries with conservative religions, characterized by their stereotypes and beliefs, but mainly in the modern western world. The barriers that trigger these inequalities are found to be related to social (such as family, religion, other beliefs or regional stereotypes), educational (such as the way children are brought up, treated in school, or advised to follow a particular path) stereotypes.

According to research, STEM related jobs are bound to increase in demand in the following decade. In the last decade, this percentage was raised by almost 10% and by 2030 it is expected to reach an even bigger growth. In 2020 only, 2.4 STEM related professional position remained unfulfilled.

The goal of this project is to target these disparities and achieve their elimination. In order to achieve this, all the participating partners opt to create a digital toolkit, by which professionals can attract, reach out and assist students to raise awareness and tackle gender stereotypes in society and in occupational choices in a digitalized world.

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