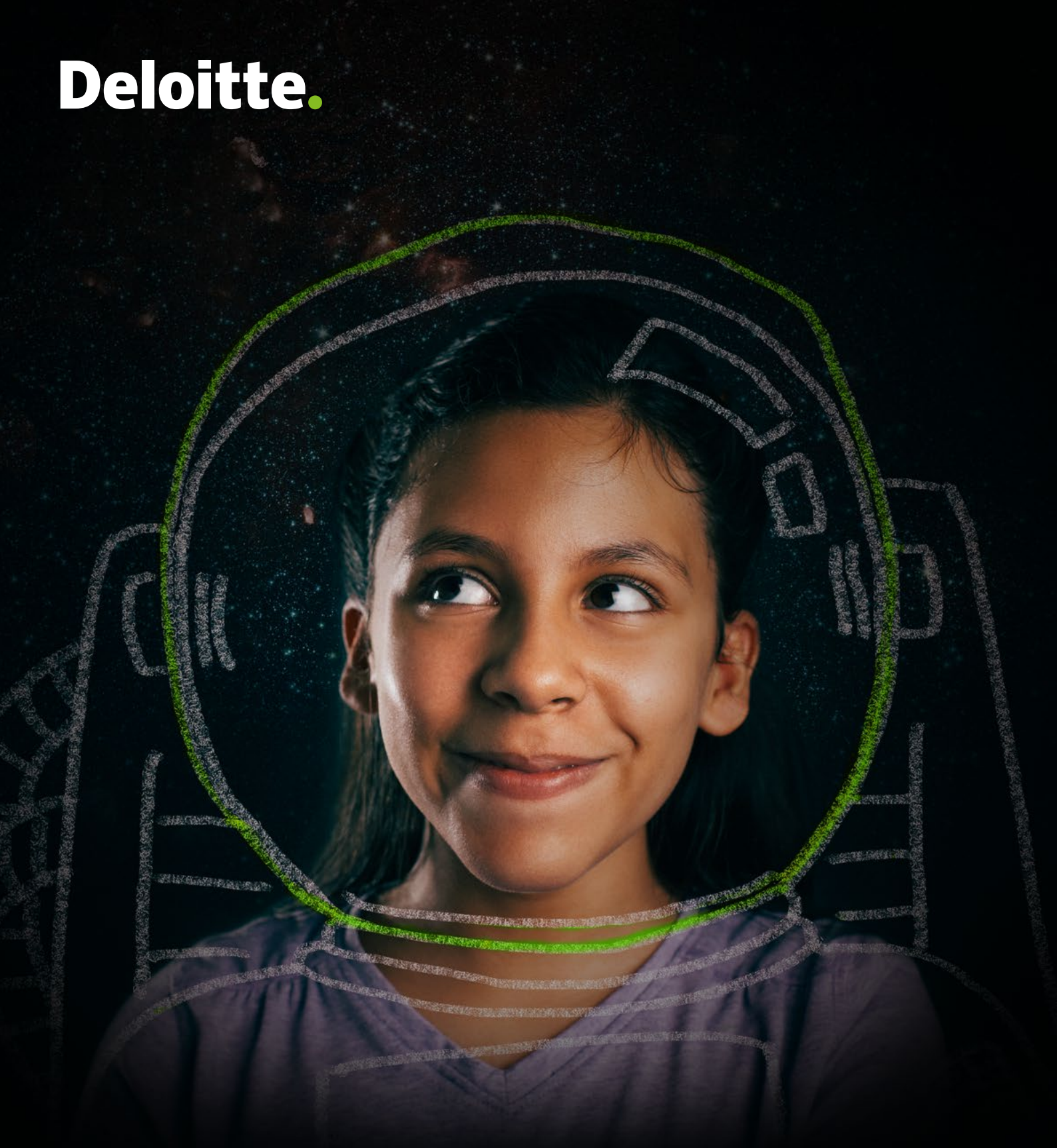
Deloitte.



Fondazione Deloitte

Osservatorio STEM

Rethink STE(A)M education

A sustainable future through scientific, tech and humanistic skills

Foreword

> My hope is that all educators and students can enjoy a common European Education Area that provides a robust foundation to overcome all challenges that this century throws at us and where teachers and students can teach and learn across borders, where our skills and experiences are mutually recognised and where we never stop learning.
>
> ***EU Commission President Ursula Von der Leyen***

> I am grateful to the women who came before me for breaking barriers. Everyone's voice has to be heard. Never wait for somebody else to talk for you. Everyone has a voice that can be as loud and the integrity of everyone's argument can matter.
>
> ***EU Parliament President Roberta Metsola***

Deloitte actively participates in policy discussions on some of today's major societal and economic issues, thus contributing to the **complex challenge of training new generations and fostering social progress** by supporting those who wish to build the capacity to break down barriers and improve skills, education and employment.

After the resounding success of the first edition in 2020, Deloitte and the Italian Deloitte Foundation decided to hold a second edition of the STEM Observatory, which explores the role of STEM (science, technology, engineering and mathematics) in this fast-changing scenario, with a view to broadening the horizons of STEM education and guaranteeing equal opportunities for future generations.

Society is undergoing a sea change, in social and cultural as well as economic and environmental terms. Notably, **Covid-19 has weighed heavily on young Europeans**, leading to a decline in in-person training and job opportunities. The pandemic has also reinforced the need for continuous training, partly by fostering willingness to shift long-standing paradigms, and introducing new learning methods and approaches. **At European level**, the pandemic has affected intra-European mobility, by reducing the exchange of educational processes and the cultural values the common European vision is based on. To heed the lesson of the pandemic, we must make European public systems and services more interconnected and accessible, sharing information and resources, in order to be ready, should the next unforseen phenomena hit us.

At global level, in order to tackle the consequences of the environmental disruption caused by **climate change**, **new professional roles for developing transversal skills** are ever more vital. **The STEAM approach, conveying the hybridization of Arts and Humanities with scientific skills** is the way forward to enable new job profiles that keep pace with an accelerating world.

In this report, Deloitte calls on key agents of change - such as communities, universities, enterprises, governments and NGOs - to take part in the process of **training new generations through STEM and hybrid skills**, and creating new paths of cooperation. To bring about the desired change, Deloitte invites these key agents of change **to create favourable conditions that allow individuals to access education and apprenticeships at all levels**.

This report, including its call for action, is aimed at contributing to the debate on the above issues, as well as proposing measures, initiatives and policies designed to fill existing action gaps and create equal opportunities for European citizens.

Before inviting you to read the report we would like to thank all the students, academia and business representatives who contributed to this study. Our shared commitment strengthens our determination to work together towards social progress.

FABIO POMPEI
Deloitte Central Mediterranean
Chief Executive Officer

GUIDO BORSANI
President Deloitte Italian Foundation
Deloitte Central Mediterranean Public Services Leader

Executive Summary

A changing society
(Chapter 1, 2)

The challenges of the 21st century are posing a threat to the achievement of **social progress, environmental and social sustainability, and peaceful relations between countries**. In this scenario, the recent outbreak of Covid-19 and ongoing climate change have exacerbated social and economic conditions at European and global level, and had a particularly striking impact on the younger generation, whose educational choices have been influenced with regard to transition and orientation to school and university.

As a core component of its agenda, the European Union strongly emphasises the importance of forging a resilient generation of young learners who are able to deal with emerging global issues. In this context, **STEM (science, technology, engineering and mathematics) education** plays a fundamental role in building a more sustainable society.

Nontheless, STEM pathways are only taken by a minority of students in Europe.

52% **STEM**
of European interviewed students
choose a **STEM degree** because they are **passionate about the subject**.

Social progress through STEM
(Chapter 3, 4, 5)

Out of the minority of students who embark on a STEM career path, and women and people with a lower socio-economic status are underrepresented. Underlying this **gender and socio-economic gap** are structural inequalities embedded in societies which prevent equal access to higher education, and especially to STEM disciplines.

Only
1 in 4
students
admits the existence of stereotyps that **keep women away** from studyng STEM.

Moreover, the assumption that STEM subjects are generally more difficult, expensive and costly in terms of time compared to non-STEM subjects acts as a barrier to STEM access. Students transitioning between secondary and tertiary education often rely on outdated information based on **gender stereotypes and cultural norms** regarding science and technology paths.

55%
of students

belive that **STEM academic paths** offered by informal organizations are a **valid alternative to university** in order to **hybridize skills**.

The STEM gender and socio-economic gap has exacerbated a growing **scientific skills gap** that is widened even further by the rapid pace of technological innovation and the rise of various emerging STEM professions. The **nature of work is rapidly changing** due to emerging technologies and disruptive forces that are challenging existing approaches to learning and working together. These changes will strongly affect the skills that employers value and rely upon. As jobs evolve, workers will need to take part in a continuous process of upskilling and reskilling.

54%
of European enterprises

are looking for **more reskilled graduates**.

One team: three actions for change

(Chapter 6)

In this scenario, Deloitte calls on key agents of change (institutions, communities, universities, enterprises and the third sector) to work together on potential reforms, policies and measures that provide youth and workers with the hybrid skills required to tackle the Today's challenges.

Key enablers play a pivotal role in influencing the debate on education, and have the potential to make the difference in shaping new learning models in view of the STEAM approach. Therefore, **generating awareness of STEM**, via initiatives that provide a non-biased view of STEM is key to leveraging young people's interest in these subjects.

Unlocking equal opportunities is a priority for achieving social and environmental sustainability. Tackling gender, cultural and socio-economic barriers embedded within our societies via **initiatives and measures that foster STEM inclusiveness and equality** is essential for guaranteeing social progress.

Finally, **rethinking the skills needed to thrive** and breaking down structural socio-economic and cultural barriers is vital for opening up equal opportunities, whilst ensuring academic and professional development for everyone, regardless of people's socio-economic status. In this context, **reskilling and upskilling** comprise a fundamental process for keeping up with fast-changing environmental needs.

Skills hybridization and transferable skills can help steer the workers of the future towards a more sustainable social, digital and climate transformation.

A combination of arts and humanities and STEM skills can provide an innovative way for tackling social and environmental challenges.

In this report, Deloitte identifies three main actions of change that key enablers should engage with, in order to actively generate a positive impact on social progress.

1 STEM Education in Europe

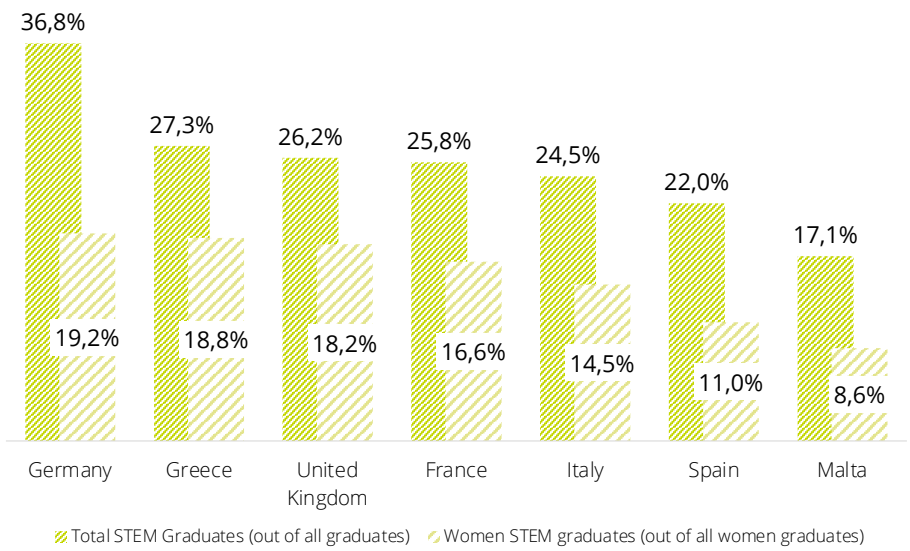
The information and all data of the research are focused on 5 targets: STEM – NON STEM Students, Universities, Young Employees, NEETs, Enterprises analysed in 6 European countries, such as: Italy, Greece, Malta, Germany, France, Spain, and in the UK.

According to the International Standard Classification of Education (ISCED, UNESCO 2012), **STEM courses in tertiary education include all engineering, manufacturing and construction programs** as well as degrees in natural sciences (such as biology, earth sciences, astronomy, chemistry and physics and related disciplines), **mathematics and statistics and information and communication technology** (ICT) programs.

STEM tertiary educational pathways are embarked on by a minority of European students. A quarter (26%) of total graduates in EU-28 countries (EU-27 + the UK) holds a STEM degree or qualification, with some variations depending on each country. This picture has been largely stable in Europe over the past five years, with virtually no change in the proportion of STEM graduates since 2016. Germany is a leading country for STEM education, where almost four graduates in ten hold a STEM qualification or degree.

EXHIBIT 1

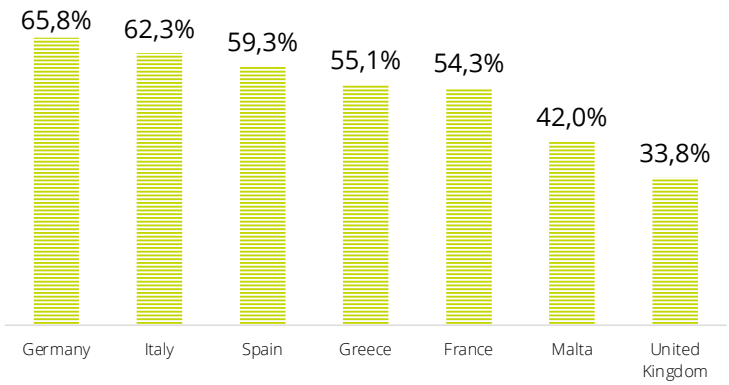
Graduates in STEM as a percentage of total graduates in 2019, drawn from Eurostat data. Aggregated EU data refers to EU-28 countries.



Source: Eurostat data. Tertiary education (ISCED levels 5-8) graduates in 2019. Data extracted in Nov-21

EXHIBIT 2

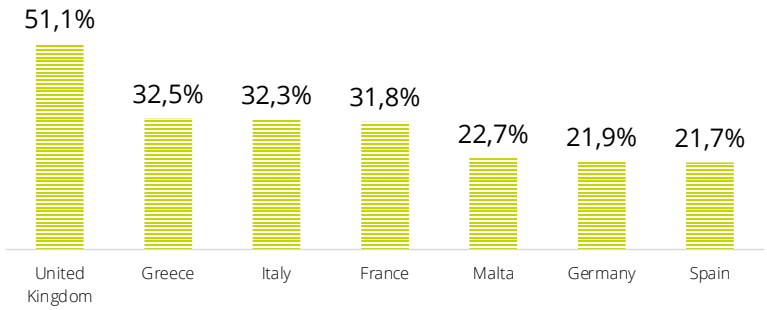
Percentage of graduates in engineering



Source: Eurostat data. Tertiary education (ISCED levels 5-8) graduated in 2019. Data extracted in Nov-21

EXHIBIT 3

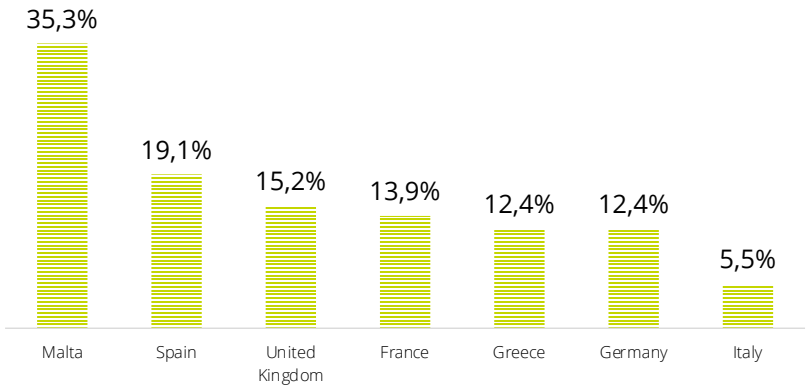
Percentage of graduates in natural sciences



Source: Eurostat data. Tertiary education (ISCED levels 5-8) graduates in 2019. Data extracted in Nov-21

EXHIBIT 4

Percentage of graduates in ICT



Source: Eurostat data. Tertiary education (ISCED levels 5-8) graduates in 2019. Data extracted in Nov-21

Engineering and manufacturing are by far the most widely studied subjects among those who chose to embark on a STEM path.

STEM disciplines show different trends among their sub-families.

However, subjects with a focus on natural studies are also very popular, as shown in the chart.

ICT disciplines are the least popular in major European countries.

Based on available data, there was no significant change in the percentage of female STEM graduates among total STEM graduates between 2016 and 2019. A slight upturn was seen in the UK, while in Germany and Malta the percentage of new female graduates in STEM disciplines fell between 2018 and 2019, from 28% to 26% and from 31% to 28%, respectively.

Educational background prior to university choice: how do young people choose their path?

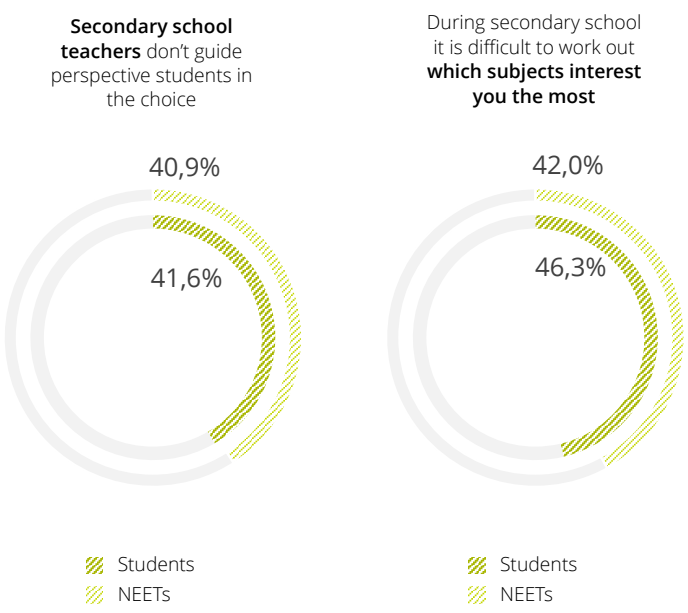
The moment of transition from high-school to university is a critical juncture for many European pupils. In the seven countries under consideration, over 30% of students and young graduates rated the transition to higher education as being difficult.

Students and NEETs interviewed in Italy and Greece mentioned the **lack of guidance from school teachers** as a challenge in the transition to the next educational level, immediately followed by **limited self-awareness of their own aptitudes and interests**. In Germany, the UK and Malta, confusion is mainly caused by scarce self-awareness with respect to one's own inclinations, capabilities and aptitudes. I**n the UK, counselling from teachers is perceived as being particularly effective compared to other countries**.

STEM tertiary educational pathways are taken by only a minority of European students (only 26% out of total graduates in countries analysed). Lack of guidance and support, and preconceptions, biases and stereotypes about STEM influence students' choices.

EXHIBIT 5

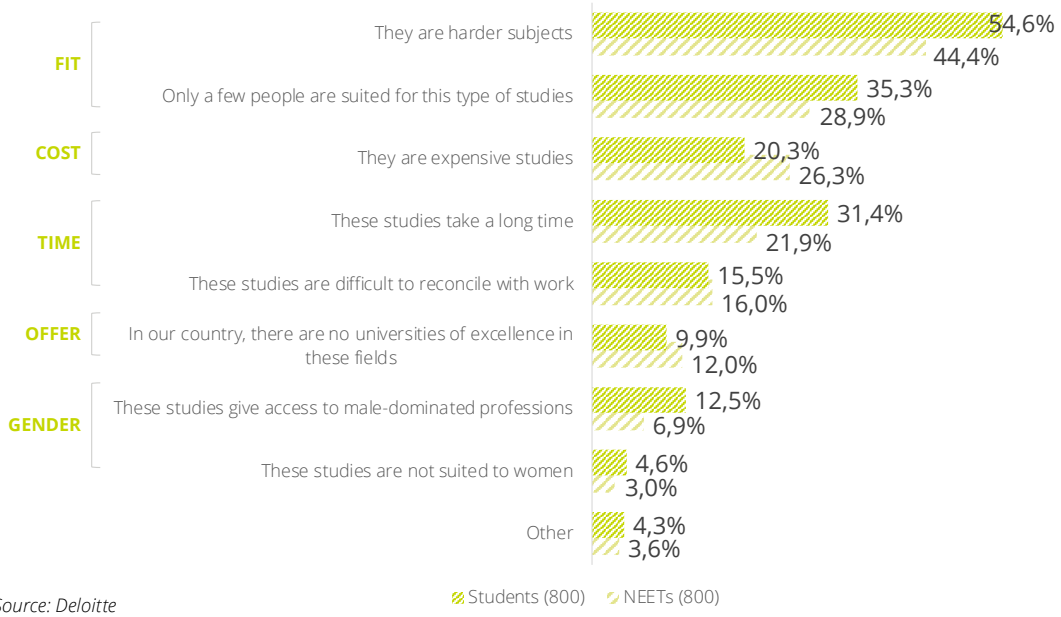
Reasons why the transition from school to higher education is difficult from the perspective of students



Source: Deloitte

EXHIBIT 6

Barriers to choosing a STEM academic path according to students



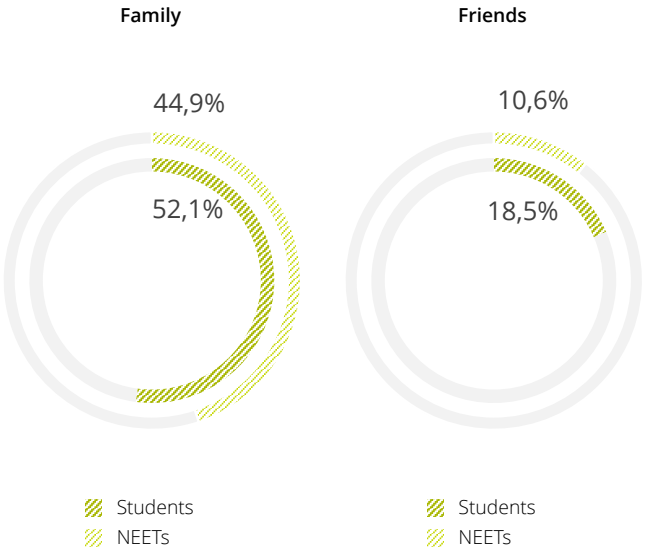
Source: Deloitte

Students, NEETs and workers also highly rate the role of **family and school** in shaping high school students' decisions about their future educational pathway. The majority of students, graduate NEETs and workers receive some form of support and advice during the transition from school to university education. Support **from high-school teachers is particularly critical for students and graduates in Greece, France and the UK, while it is less relevant in Italy, Malta and Spain.** By contrast, **some critical issues regarding the role of family and school in guiding the transition phase also feature prominently in the interviews**. For example, the strong perception that the opinion of one's family about STEM career paths often depends on deeply rooted socio-cultural norms poses a challenge. Family members rely on readily available examples, such as **focusing on the careers of acquaintances or relatives, rather than on factual information about the state of the job market**.

Misguided support can push students farther away from STEM degrees and careers. Higher education representatives strongly disapproved of high school teachers giving advice to students based on their past performance, as this practice could **foster a fixed mindset which has been linked to worse future performance in quantitative subjects** (Muenks et al., 2020).

FIGURE 7

Source of support in the transition to a higher education level among students and graduates



Source: Deloitte

Two factors primarily influence high school students' choice of their future path: **passion** and **future job opportunities**. Regarding both STEM and arts subjects, students highly value personal inclinations in making their choice. **For both STEM and Arts and Humanities courses, passion is a decisive factor for students**. While for Arts & Humanities students, the profitability of future career paths is rarely taken into account, STEM peers **focus more strongly on job opportunities**, in terms of the greater variety of opportunities as well as the expected economic return soffered by STEM degrees.

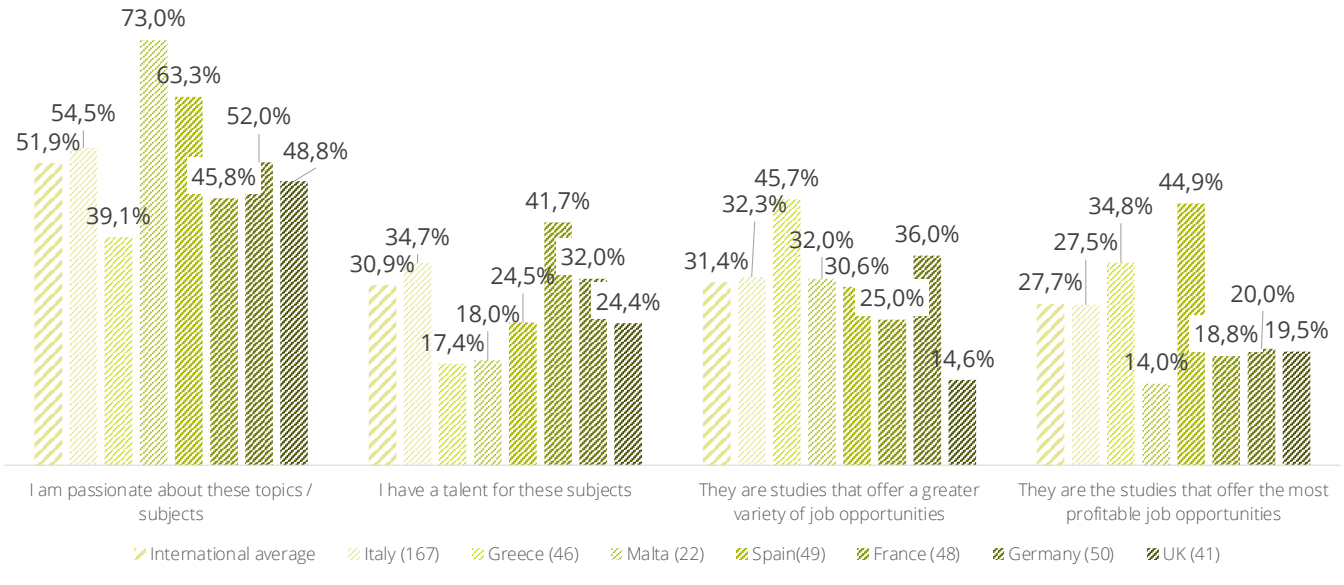
Stereotypes and biased opinions about STEM disciplines shape student's educational choices (European Institute for Gender Equality, 2018). One element is clearly identified as a deterrent to choosing STEM paths: on balance, **STEM subjects are perceived as being more difficult than non-STEM subjects, and it is commonly believed that they are only suited to some people**. This result does not significantly vary across the countries and targets considered, where **students and NEETs believe that these disciplines are not suitable for women, showing the persistence of deeply rooted gender stereotypes, at least among a minority of respondents**.

In a nutshell, **lack of self-awareness, misguided advice, fixed mindsets, and the idea that STEM degrees are too difficult, too long and too expensive for the average student**, might deter a substantial number of high-school students from studying STEM subjects in tertiary education.

Students' decision torn between Passion and Stereotypes

Interviewed students strongly value passion when deciding to undertake a career in STEM, as more than half of interviewed students stated they chose a STEM degree because they were passionate about the subject. On the dark side, however, stereotypes strongly influence students' interest towards STEM subjects, making it an elite field.
To guarantee that every student makes an informed decision on their career path, awareness on STEM disciplines should be raised.

FIGURE 8
Drivers of course choice among university students who attend a STEM program



Source: Deloitte

From graduation onwards: zooming in on doctoral STEM education

The decision to pursue further education after graduation, or to directly dive into the job market, is crucial. STEM doctoral degree holders fare better compared to their non-STEM colleagues, both when it comes to post-graduation income and in terms of the likelihood of being able to do research after graduation (OECD, 2019).

In the European countries under consideration, **PhD holders with a STEM specialization accounted for over 32.5% of total PhD graduates**. Doctoral degrees might not be a viable option for all STEM graduates. The standard duration of a scientific PhD program in Europe is 3.5 years, and normally only master's degree graduates may apply, which adds up to a total of around nine **additional years of studying** after high school. Prospective PhD candidates might have to take into account substantial **opportunity costs** when pondering whether to pursue further education.

The situation for women changes significantly from STEM degrees to PhDs. Indeed, in all countries considered more than 44% of Ph.D graduates are female.

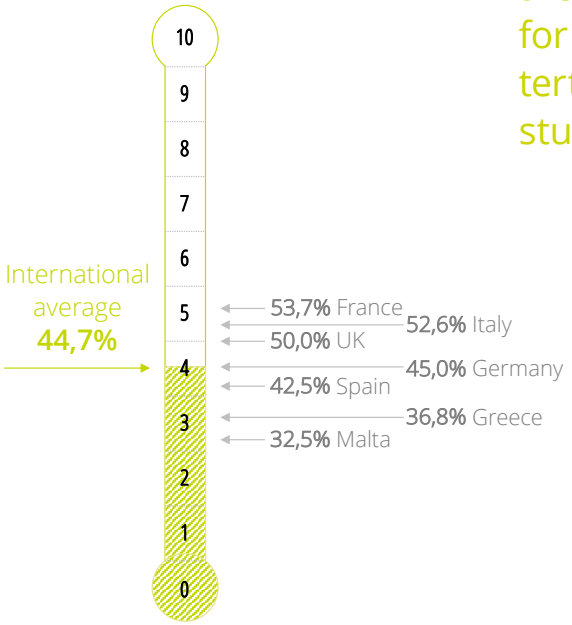
As an alternative to PhDs, a vast array of new STEM upskilling opportunities is blooming at an increasing pace. **Non-formal educational institutions offering post-graduate specialized master's programs** and degrees are growing in popularity all over the world.

Why are STEM skills so valuable to employers in the first place, and what do future trends look like?

By unveiling the skills and professions of the future, formal and non-formal STEM education will help bridge the existing skills gap, thus providing young workers and NEETs with the reskilling and upskilling opportunities they need to adapt to rapidly evolving industrial and economic requirements.

Only 32.5% of total PhD students are enrolled in a STEM specialization. Of these, women account for at least 44% in countries considered. However, STEM PhDs are not a viable option for the majority of tertiary education students.

EXHIBIT 9
PhD graduates in STEM subjects



Source: drawn from Eurostat data. Doctoral or equivalent level (ISCED level 8) graduates in 2019. Data extracted in Nov-21

2 A rapidly changing environment: the future of work from a business perspective

Mirroring a fast-changing economic ecosystem, many job roles and careers are undergoing rapid transformation. **The hybridization of hard and soft skills, and the fast pace at which new roles and professions are emerging, is generating great pressure to upskill and reskill workers and jobseekers**.

In response to the constant influx of digital and technological innovation that is affecting European economies, advanced digital skills are becoming more important day by day. However, the capacity to form STEM professionals to fill existing job vacancies is still below par. This is the so-called “skills gap”.

Finally, the drive towards digitalization, and the growing complexity of the challenges traditionally faced by third sector organizations, are also bound to trigger a surge in the need for a highly specialized and science-savvy workforce in the not-for-profit ecosystem.

Labour demand and the skills gap: an impediment to growth

The scarcity of candidates with specific skills sets on the job market is an obstacle to social progress, equality and digitalization.

Skill mismatches are a major barrier to companies' productivity, growth and digitalization, and also give rise to misplaced expectations among students and young graduates. **The lack of STEM candidates is of particular concern to European companies**. On average, around 55% of European recruiting organizations **report difficulties in filling ICT vacancies**, including over 70% of such firms in Czechia, Austria and the Netherlands (European Commission, Directorate-General of Communications Networks, Content and Technology, 2021).

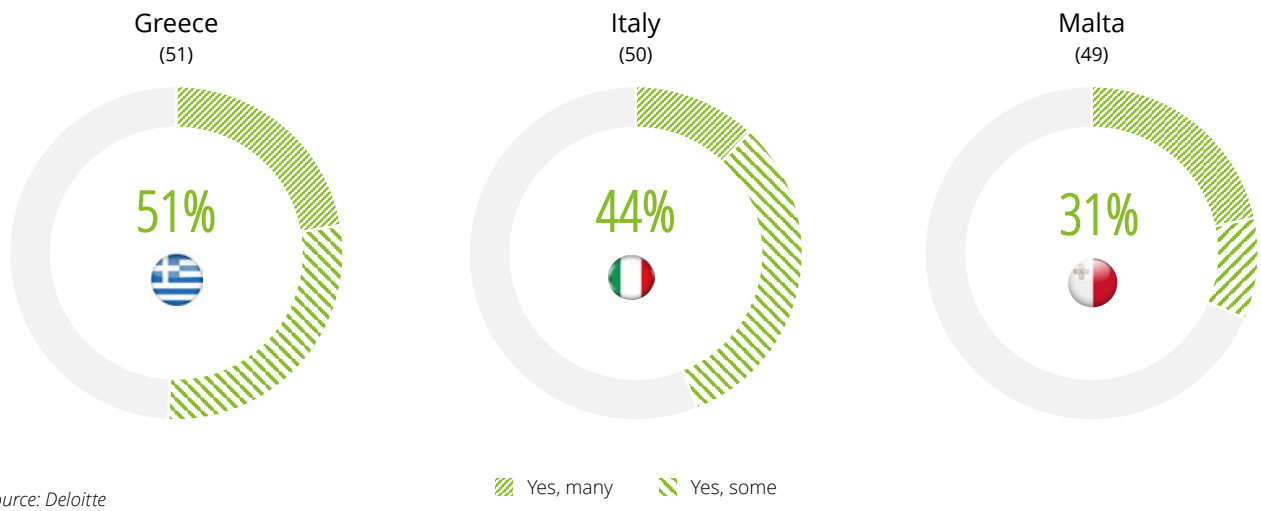
When asked if they have difficulties hiring professionals with a STEM background, more than 44% of Italian respondents said that they do to some extent, whereas 36% replied that they never have such difficulties, or only to a slight extent.

This figure is slightly lower for Italian employers, standing at 20%. Greek interviewees were the most knowledgeable about this issue.

Awareness was especially low among Small and Medium Enterprises (SME) owners, which might indicate **scant awareness of the skills gap, and perhaps limited knowledge of STEM degrees and skills** and their value for the companies in question.

EXHIBIT 10

Difficulties faced by Italian, Maltese and Greek employers in attracting STEM graduates



Source: Deloitte

A dynamic landscape: emerging and declining STEM professional profiles

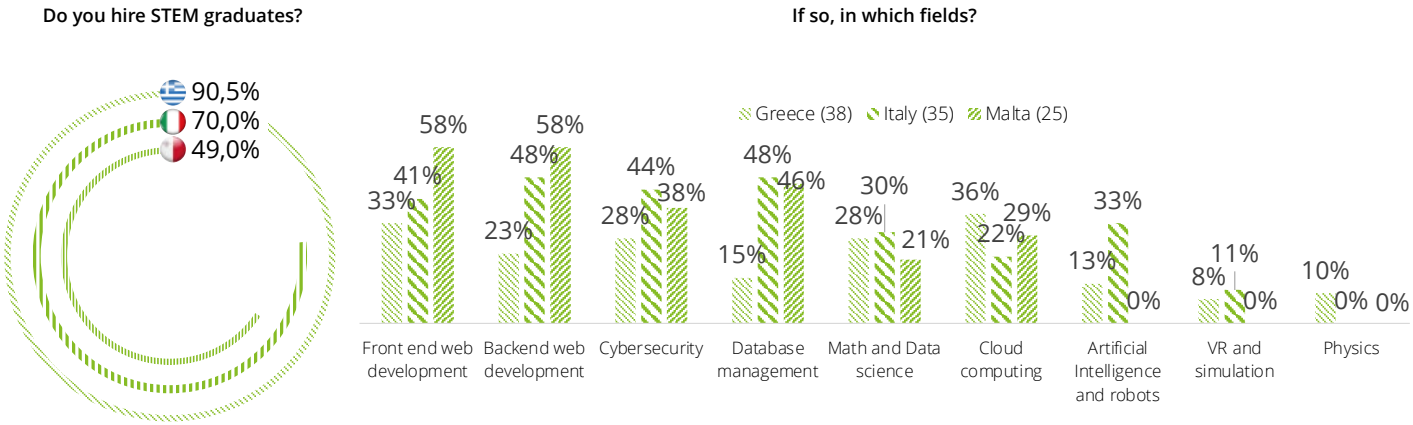
STEM roles are **driven by emerging digital professions, especially data science and analysis, artificial intelligence and cloud computing**.

In Malta, Italy and Greece, STEM graduates are most commonly hired for **top roles closely linked to the digital economy**, although the spread of emerging technologies is **still limited, especially in Malta**. Indeed, demand is highest for traditional programming or coding roles, such as **front-end** and **back-end** developers. These are followed by cybersecurity and database management roles, with the latter accounting for the most hires among Italian employers, together with back-end web development roles. Then come emerging IT roles, in such fields as data science, cloud computing and artificial intelligence.

Due to the skills gap, the upsurge of emerging STEM professions - most notably in the fields of data science, artificial intelligence and cloud computing - has also increased the need for upskilling and reskilling of the workforce.

EXHIBIT 11

Main destinations of STEM graduates in Italian, Maltese and Greek companies



Source: Deloitte

Which skills and profiles are companies looking for?

The rapid evolution of the job market makes it difficult to pinpoint a defined set of skills that will continue to be in high demand throughout the next decade; the average life of skills today, in fact, does not exceed 5 years. However, based on recent developments, some general trends may be outlined.

The growing importance of advanced digital skills is driving the demand for STEM professionals. **Predictably, the most sought-after hard skills are IT competency and mathematical and statistical knowledge**. HR and strategic business departments representatives highlight the growing importance of "data" knowledge, given the upturn in the use of "big" and "small" data for business purposes. Business leaders also stress the importance of developing a data strategy for companies competing in the marketplace. To deploy such a strategy, it is vital to attract employees with a strong data background. However, the range of key hard skills in the world of STEM is continuously expanding, due to emerging innovation technologies. The most in-demand hard skills in the STEM arena are not only related to data, but also to software development, programming, robotics and automation, machine learning and artificial intelligence.

In addition to **analytical thinking** and **complex problem-solving**, the top skills of the future will include **critical thinking**, **creativity, originality, adaptiveness and resilience**, as well as various kinds of interpersonal skills (World Economic Forum, 2020). Italian business leaders agree that the so-called "soft skills" should not be underestimated, and these are often included in companies' continuing education programs. However, employers argue that soft skills are often underplayed by Italian, Greek and Maltese academic institutions, resulting in a lack of communication and relationship skills. An additional source of concern across the board are problem-solving skills.

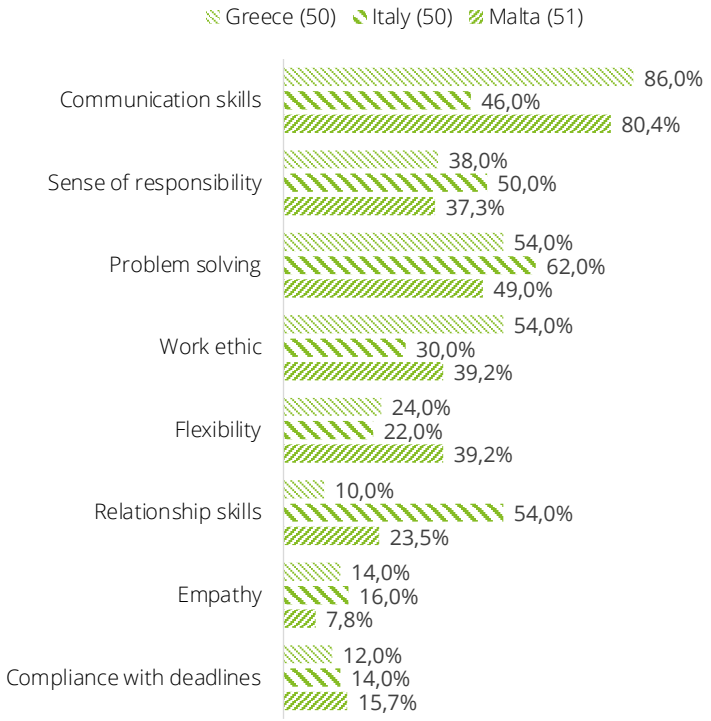
A propensity to learn new skills and a **readiness to adapt to change** are key to thriving in this environment, and this no longer applies only to students and new graduates. The concept of lifelong learning is gaining traction across the entire workforce.

But how can new skills be acquired?

Are there alternatives to formal educational pathways, and how are they perceived by employers and jobseekers?

EXHIBIT 12

Skills in demand according to Italian, Maltese and Greek employers



Source: Deloitte

New paths to a STEM career: the untapped potential of non-formal education

Reskilling employees will be essential in the short and long term. Alternative education such as non-formal education and self-learning represent a great opportunity for rapidly creating a transferrable skills' set.

Many industries are increasingly impacted by the rise of emerging technologies. Innovations are occurring at a breakneck pace, driving the need for a flexible workforce that can adapt to such rapid and unpredictable changes. In response to this trend, demand for profiles featuring a more general transferable skills set is already growing. It is estimated that more than **half of the employees (54%) on the global job market will need reskilling in the next five years** (World Economic Forum, 2019).

Both employers and students believe that the best way to acquire new skills is by gaining new qualifications and degrees from **traditional educational institutions**. However, not all formal educational institutions are fully prepared to cope with the urgent and changing needs of the job market. While some professions require the kind of in-depth knowledge that can only be acquired through bachelor's and master's degrees or similar qualifications, many others do not. According to the World Economic Forum (2020), anyone wishing to master statistical programming needs an average of only **76 days of intensive learning**.

Alternative opportunities for rapid reskilling and self-learning are on the rise. The popularity of "non-formal education" study paths, which include non-accredited courses, as well as master's and boot camp teaching programs teaching both STEM and non-STEM know-how, has seen a recent surge (Future of Jobs, 2020).

Non-formal education involves planned and structured programs aimed at providing students with a range of skills and competencies, but does not fall within the scope of the accredited programs provided by recognized institutions (Council of Europe, European Youth Foundation, 2022).

EXHIBIT 13

Satisfaction with graduates' skills expressed by Italian, Maltese and Greek employers

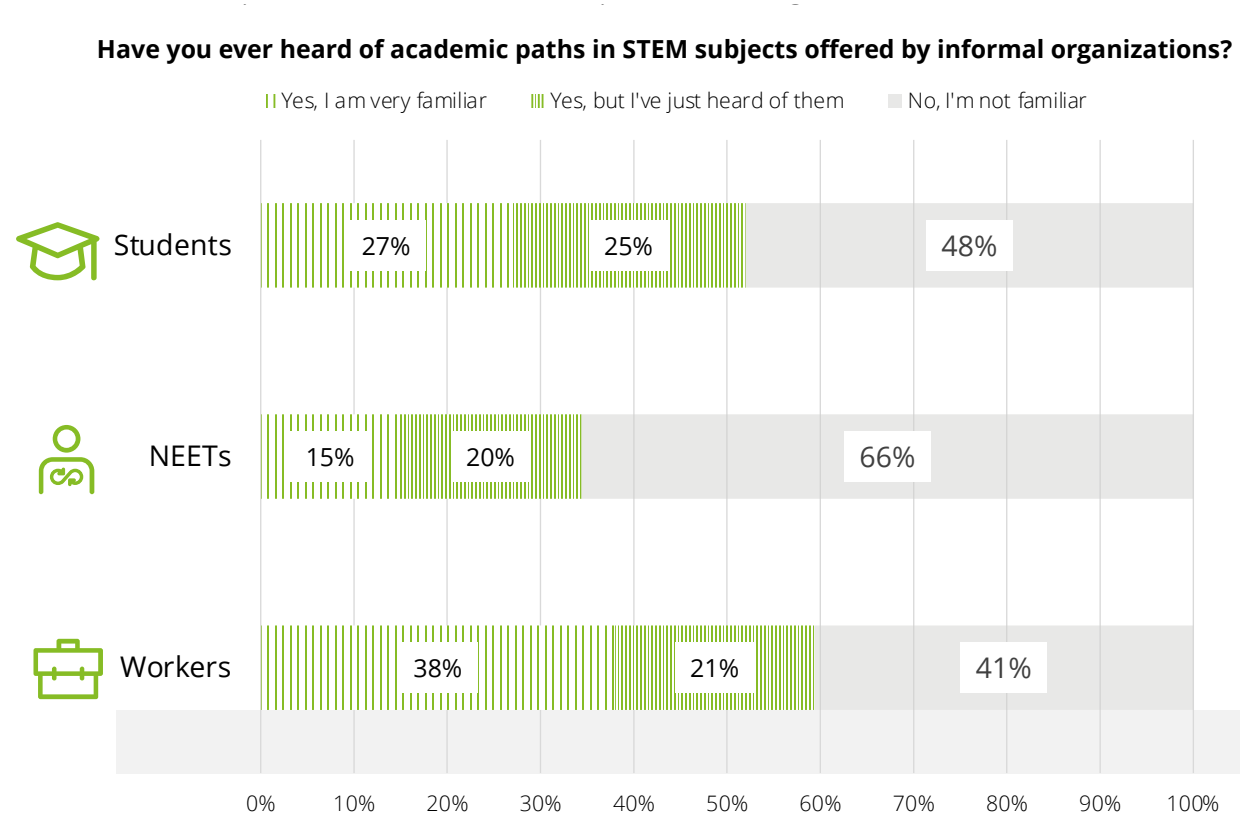
Source: Deloitte

Furthermore, **corporate training is experiencing a change of pace**. This is necessary for two reasons: on the one hand, due to the turnover in skills required by companies, which are evolving rapidly; on the other, because of the adoption of new ways of working, especially in recent years with the rapid shift towards hybrid methods, in which the worker chooses when and how to acquire new skills. In this scenario, the culture of '**Continuous Learning**' or '**Learning in the flow of work**' is pivotal, as it underlies the concept that learning and training are not confined to certain periods of a person's life but last a lifetime. This culture involves the integration of training into daily work activities through social learning mechanisms (e.g., communities, mentoring and shadowing) and the integrated use of technologies, namely digital reality (Workforce Development: Equipping the Workforce for the Future – Deloitte, 2020).

While European students, NEETs and workers confirm **that non-formal education is a valid alternative to degrees and other formal qualifications, there is still little awareness of alternative education pathways**. European NEETs are unfamiliar with these options, as are students from southern European countries such as Italy, Malta and Greece. German students are the most sceptical, with around four students in ten expressing doubts about the validity of using master's and boot camp programs as a main learning source, seeing them rather as a support tool to complement formal qualifications.

EXHIBIT 14

Students', NEETs' and workers' awareness of STEM academic paths offered by informal organizations

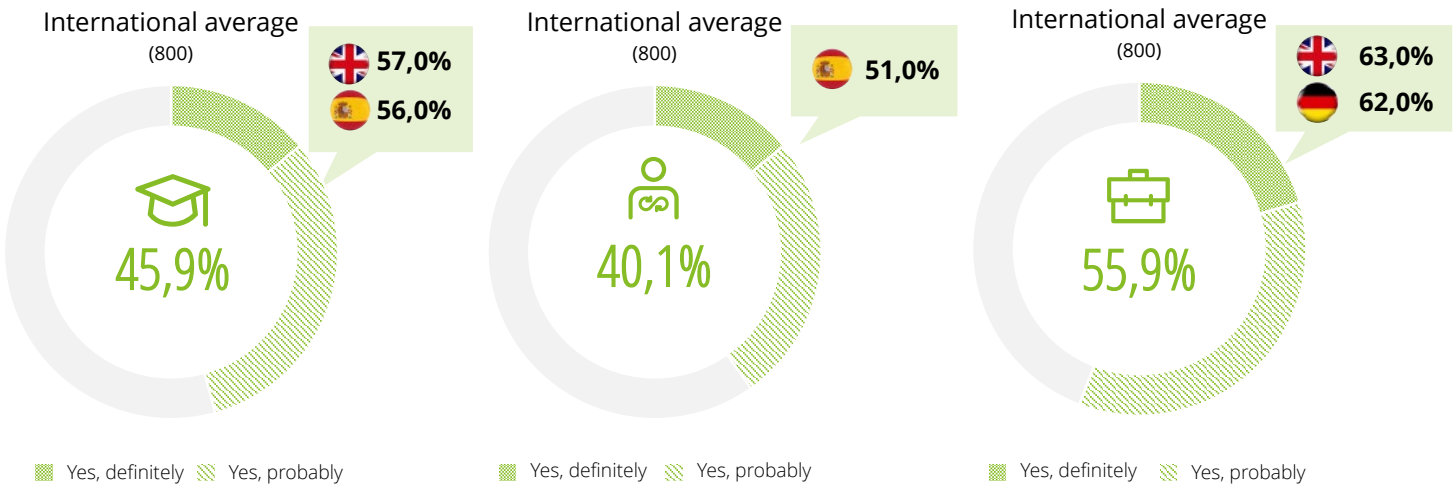


Source: Deloitte

Employers voice scepticism about alternative educational options, and a large share of them have no idea whether or not such options offer a good alternative to a formal educational pathway. The knowledge gap is particularly acute in Italy, where 52% of the respondents have little knowledge of this topic. Moreover, with regard to the business world, most of the interviewed enterprises still seem to prefer recruiting workers with a traditional background: only 4% of the Italian companies actively select professionals who have completed boot camp and academic programs.

By giving priority to meeting socio-political challenges rather than financial returns, non-profit organizations play a key role in the ESG (Environmental, social and governance) sphere. But how can STEM education generate value for the third sector and build its capacity to deal with societal and environmental change?

EXHIBIT 15
Experience with informal STEM paths



Source: Deloitte

The non-profit sector: how STEM skills can expand opportunities for pupils beyond the business realm

STEM skills are increasingly important for the development of the third sector. The issues tackled by third sector actors are getting more complex day by day: climate change, the refugee crisis and emerging geo-political tensions are just some of the areas of intervention in which European non-profit organizations are involved. Actors from the non-profit ecosystem can benefit from the digital, analytical and quantitative skills that STEM specialists can bring to the table.

Digitalization will become increasingly important for non-profit organizations, especially as a means for giving a fresh boost to fundraising activities after the disruption caused by the Covid-19 pandemic (European Fundraising Association, 2017). **Seven in ten European non-profit organizations report that they increased their use of digital technologies between 2020 and 2021**.

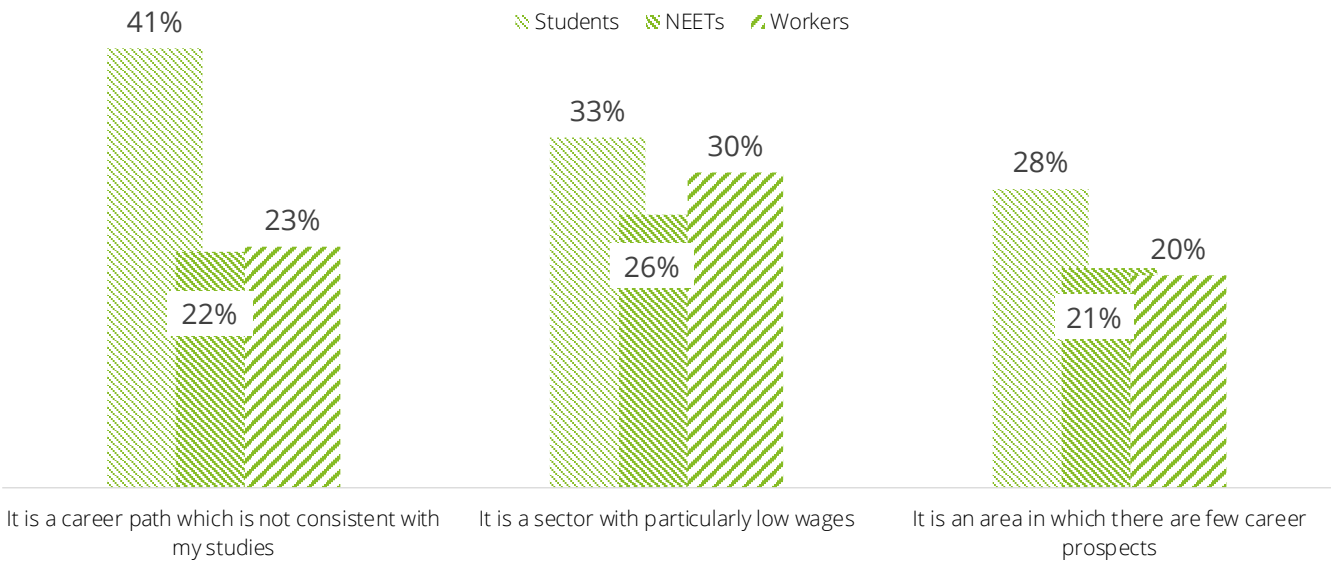
The third sector is not always considered a valid career destination by students of non-STEM and STEM disciplines alike. 25% of the European students and workers interviewed pointed out that a **career in the non-profit sector is not pertinent to their educational pathway**.

Italian (37%) and Greek students (39%) also stressed the potential lack of career prospects.

University leaders note that wealthier female students generally find opportunities in the non-profit sector to be more attractive. Showing **how STEM degrees can be useful for a career in the non-profit ecosystem** could help reduce the underrepresentation of women in STEM subjects.

EXHIBIT 16

Reasons for not working in the third sector



Source: Deloitte

Barriers to educational pathways: gender and socio-economic inequalities

Numbers highlight a persistent underrepresentation of women in science, technology, engineering, and mathematics over time (Kahn & Ginter, 2017). This gap is a major obstacle to achieving gender equality, as it does not allow for social progress and denies equal access to opportunities across a broad spectrum of sectors.

Gender disparities begin in primary school, when girls start to form their identity and their perception of their abilities in STEM subjects. **Cultural norms and role models in the representation of STEM subjects play a fundamental role in children's learning and development processes**, so it is essential that policies and practices aimed at reducing the gender gap are implemented, starting with how women's presence in STEM fields is represented and portrayed.

Moreover, socio-economic barriers are explored in terms of the challenge they pose for many students who might approach the world of STEM. This issue is also related to the role played by the family, especially parents, when children get to the point of choosing their educational pathway. **High education costs** are an obstacle to equitable access to education, and such elements as **social status**, **inadequate knowledge of STEM paths and future job opportunities**, and the influence of parental opinion, severely hamper the freedom of choice of young people whose decisions are often influenced by their family background.

Women and STEM education

Globally, only 18% of women in tertiary education are enrolled in STEM or STEM-adjacent degrees *(Unicef, 2020)*. The existing STEM gender gap not only poses a great obstacle to the achievement of gender equality, but also further hinders equitable access to future job opportunities.

The gender gap in STEM education: an overview

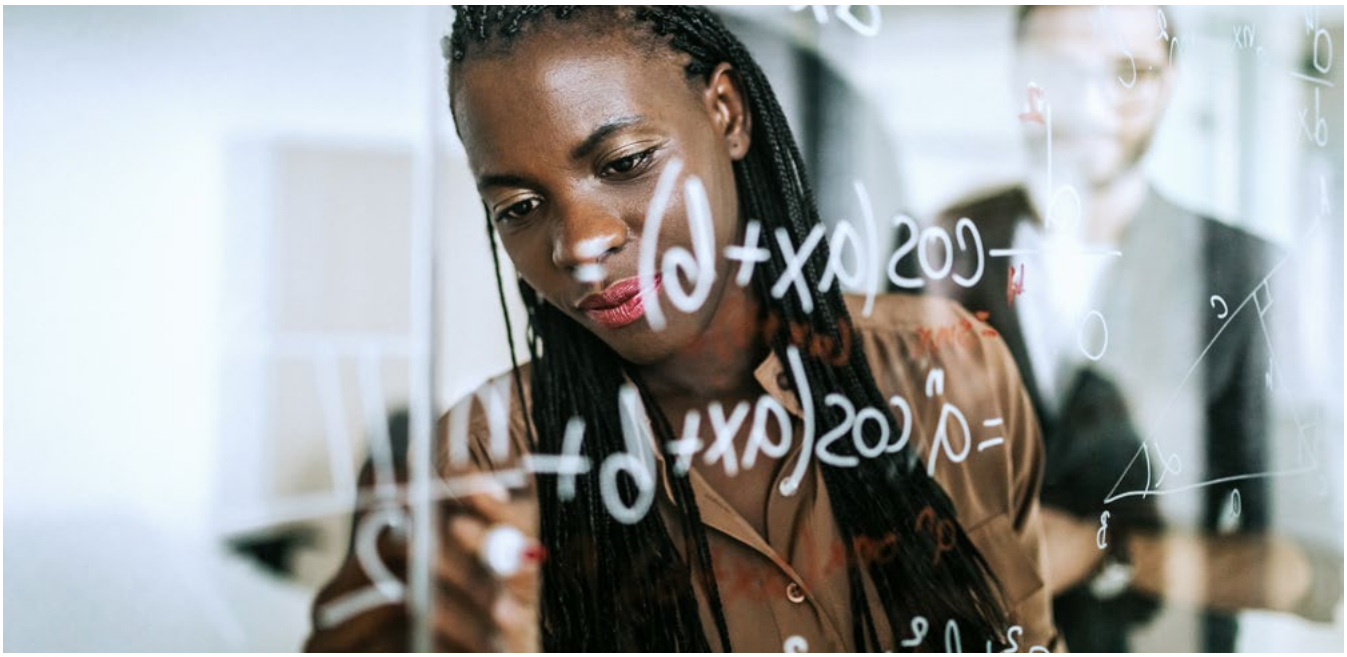
The European Parliament has forecast that there will be around 7 million new STEM jobs by 2025 in Europe (UNESCO, 2017). However, fewer women participate in STEM sectors, be it in higher education, jobs or entrepreneurship (European Commission, 2022). To fill the expected vacancies by 2030, girls and boys, and women and men, need equal access to STEM education.

Higher education authorities have expressed major concerns about the **scant participation of women in STEM degrees at their institutions**. According to higher education representatives, this is because women feel less confident about their quantitative and scientific abilities, and do not see a STEM path as a viable option due to preconceptions about discrimination against women in technical and scientific professions. They are also concerned about having to choose between family and care obligations and a fulfilling career in this field.

258 years to gender equality in STEM

Women comprise a minority of the STEM disciplines. Highly male-biased disciplines tended to show especially slow improvement in the gender ratio with time. More specifically, it is estimated that, to reach a gender ratio of workers in STEM that comes within 5% of parity, it will be 258 years (Holman et al., 2018).

Female participation in tertiary education has risen sharply since the 1980s, ultimately leading to women outperforming men with regards to their participation in education (UNESCO, 2021). Looking at the general population of European graduates in 2020, more than half are female (Eurostat, 2020).



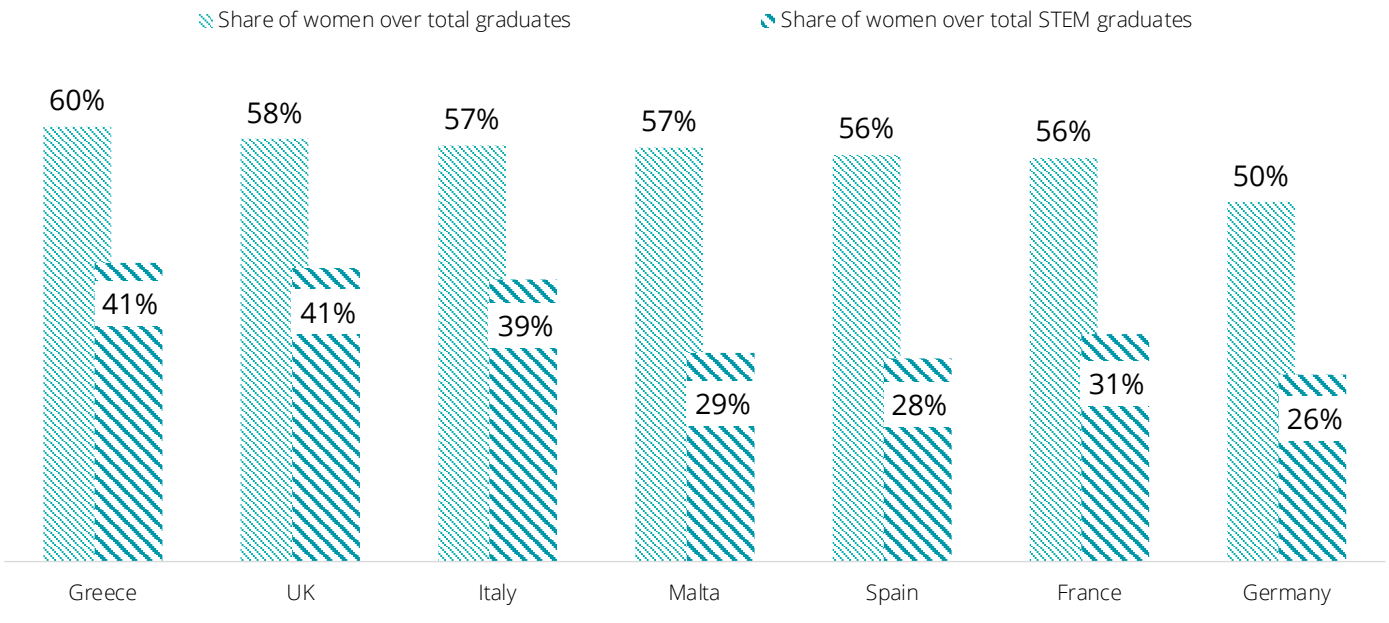
This picture changes significantly if only STEM degrees are taken into account, as the graph shows. Once again, the situation appears to be substantially better in Greece, where **41.2% of STEM graduates are women**.

On the other hand, in Germany, where males with a STEM degree represent more than half of the total male graduate population, only one graduate out of four in these fields is a woman.

In most of the countries considered, women represent less than one third of total STEM graduates.

EXHIBIT 17

Presence of women among STEM and non-STEM graduates



Source: drawn from Eurostat data. Tertiary education (ISCED levels 5-8) graduates in 2019. Data extracted in Nov-21

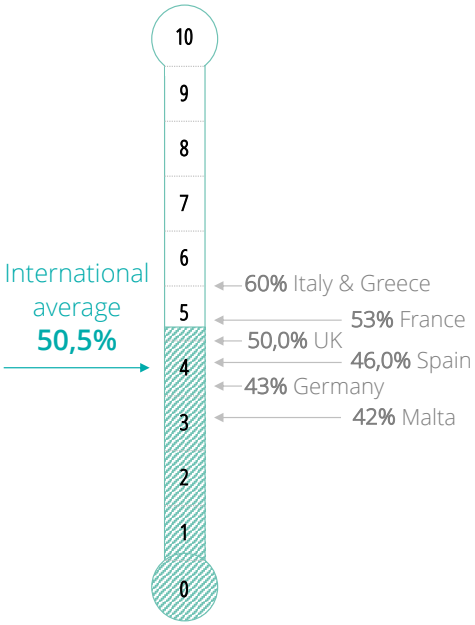
There is little improvement when considering higher levels of educational attainment, such as doctoral degrees. **Among PhD holders, the share of women is slightly higher** than for undergraduate degrees, but their participation is still less than for men (44% of women presence over total STEM PhDs in countries analysed)..

In all the countries considered in this analysis, most young workers acknowledge that discriminatory practices exist in the job market. In all countries, more than one third of women interviewees, and around half in the UK (50%) and Italy (60%), have experienced some form of unfair treatment at their workplace.

EXHIBIT 19

Women are discriminated against in STEM professions

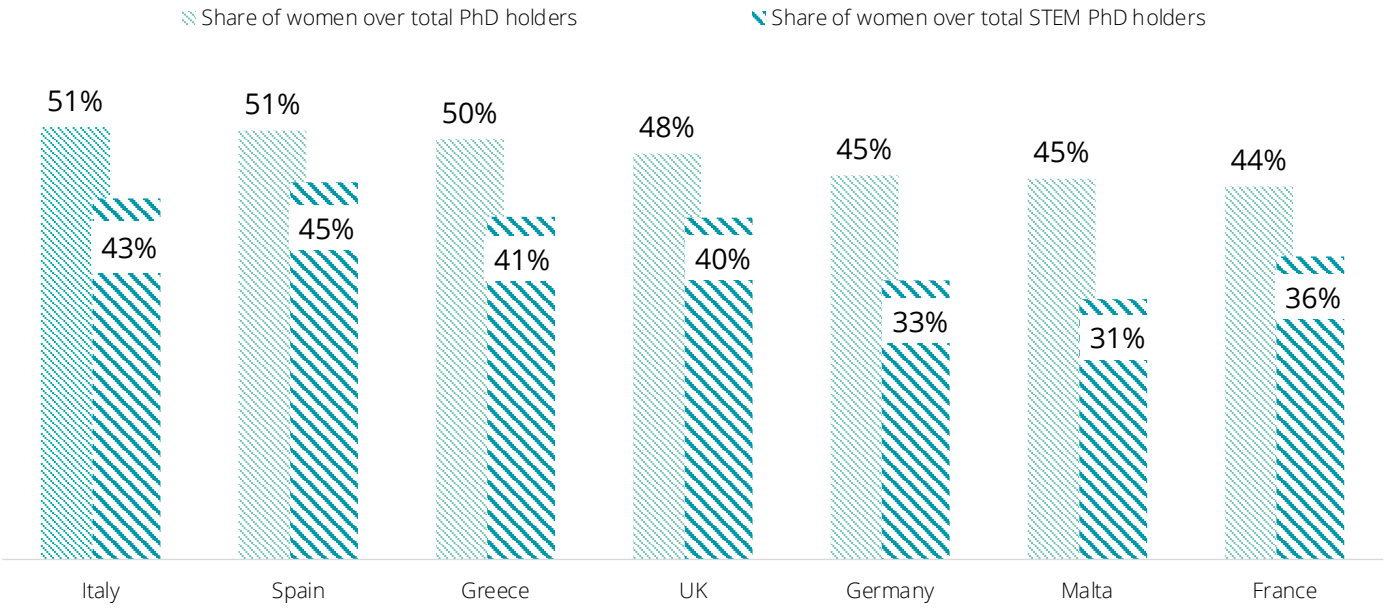
Percentage of workers who perceive women discrimination in the workplace



Source: Deloitte

EXHIBIT 18

Presence of women among STEM and non-STEM PhD holders



Source: drawn from Eurostat data. Tertiary education (ISCED levels 5-8) graduates in 2019. Data extracted in Nov-21

A deep dive into STEM families

While the gender gap seems to be an issue for STEM degrees in general, its relevance varies with respect to the various sub-families that fall under the ISCED definition of STEM (Chapter 1).

Natural and biological sciences are an exception to this general picture. In Europe, **women represent almost half (48%) of total graduates in natural sciences and mathematics**.

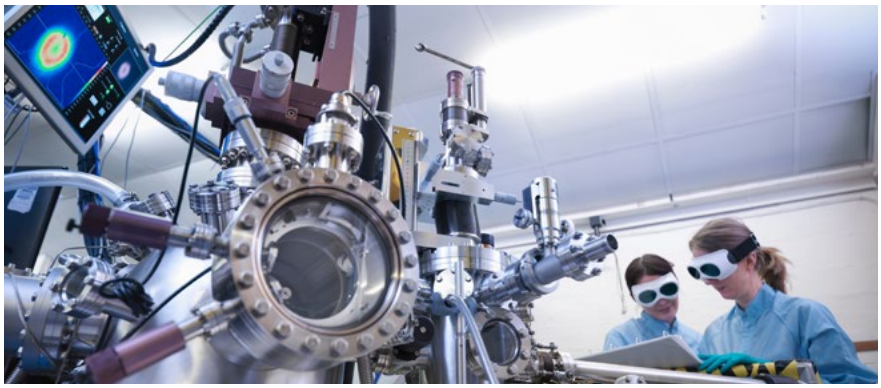
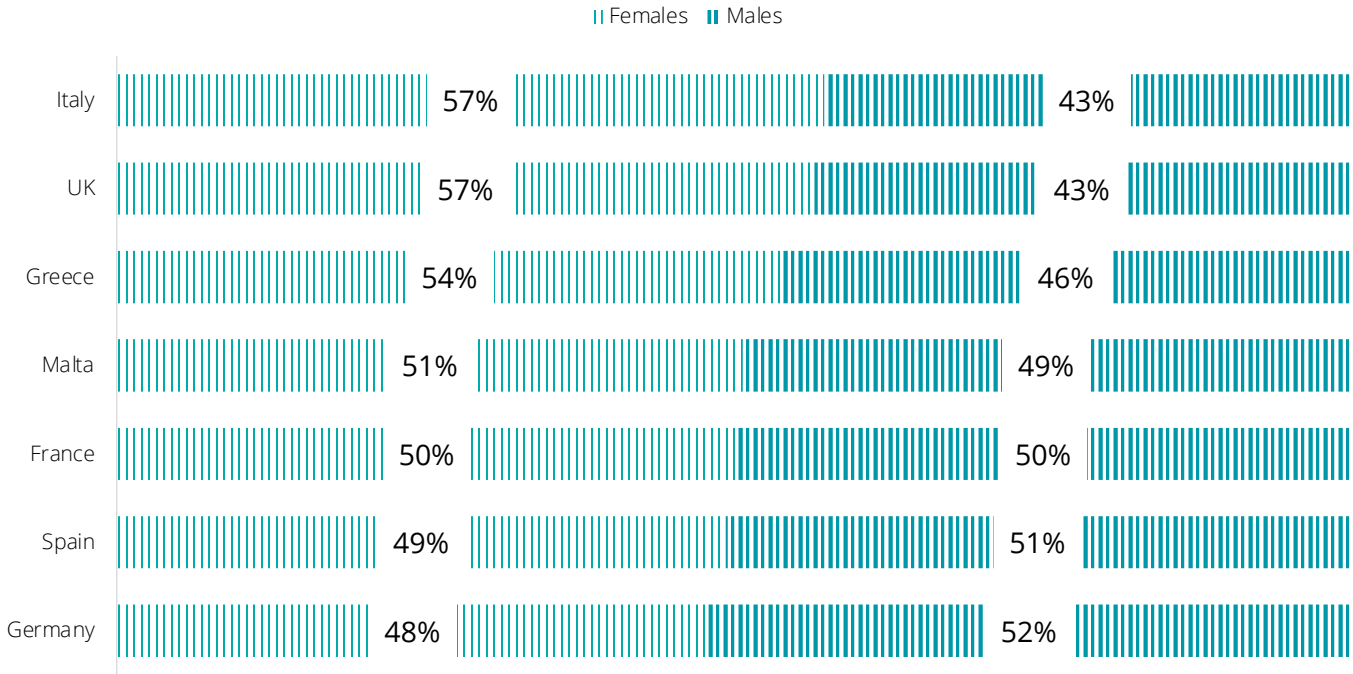


EXHIBIT 20
Presence of women in natural sciences



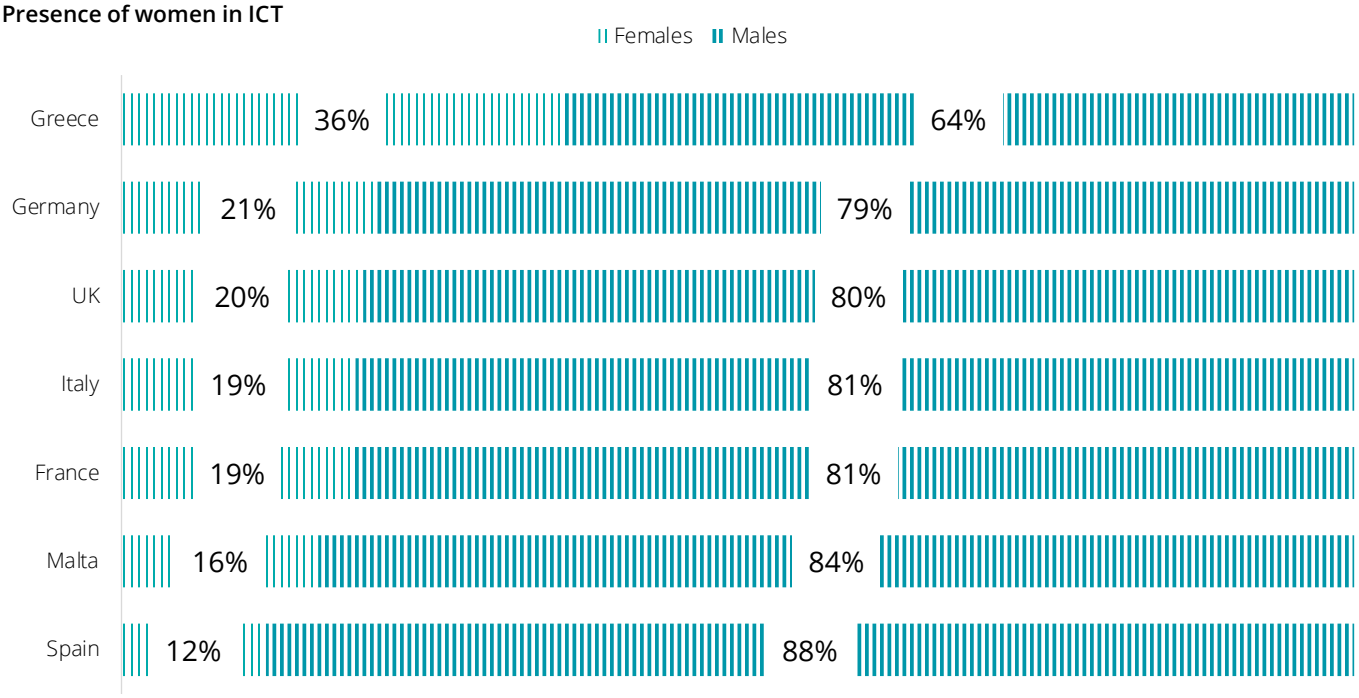
Source: drawn from Eurostat data. Tertiary education (ISCED levels 5-8) graduated in 2019. Data extracted in Nov 2021

Women's participation in STEM subjects varies according to the STEM family. While women graduates in natural sciences and mathematics are almost half of the total, there are far fewer female graduates in ICT and engineering.

More concerning is the scarcity of women with an ICT background. In all the countries considered, the **20% of ICT graduates were female**. It should be noted that this figure has slowly but surely improved over time, with the total number of women with an ICT degree in the EU growing by about 37% in the period 2010-2020 (Eurostat, 2021).

EXHIBIT 21

Presence of women in ICT

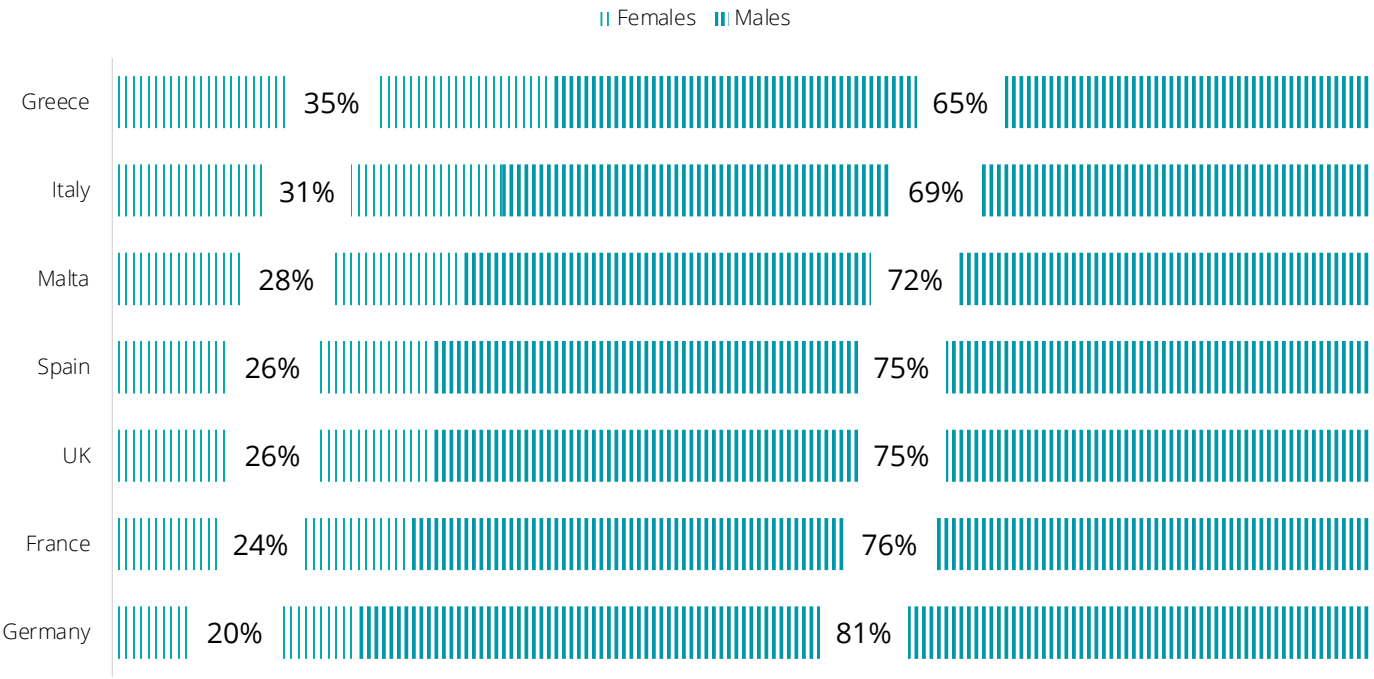


Source: elaboration on Eurostat data. Tertiary education (ISCED levels 5-8) graduated in 2019. Data extracted in Nov-21

A similar picture applies to Engineering degrees, where **women account for a little more than 20% of the total number of European engineering graduates**.

EXHIBIT 22

Presence of women in Engineering



Source: elaboration on Eurostat data. Tertiary education (ISCED levels 5-8) graduated in 2019. Data extracted in Nov 2021

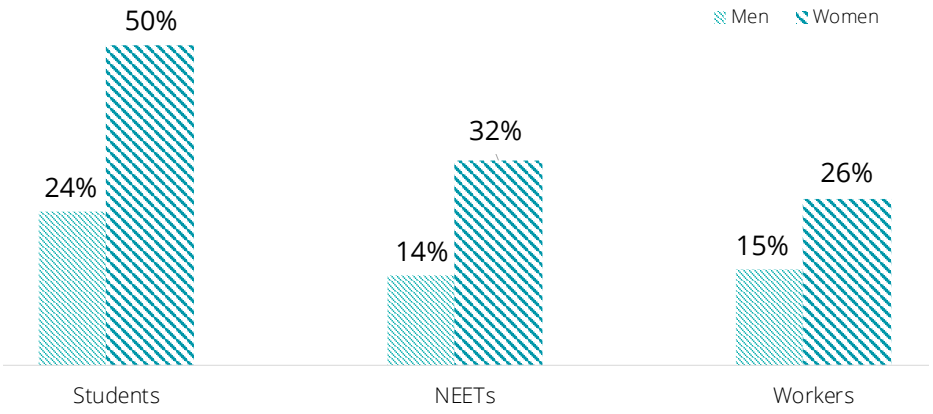
Women in STEM education: the importance of role modelling

According to the higher education representatives interviewed, cultural stereotypes about girls being more people-oriented, creative and willing to help others than boys jeopardise their participation in STEM subjects. Much of such prejudice stems from the media and popular culture, but the family and educational environment also play their part.

EXHIBIT 23

Stereotypes that prevent women from studying STEM subjects

Percentage of respondents who think there are stereotypes in their country today that keep women away from studying STEM subjects (by gender)



Source: Deloitte

Matilda Effect

In 1993, the historian of science Margaret W. Rossiter coined the expression "Matilda effect" to describe the sexist nature of the failure to recognize women in scientific research, and the systematic attribution of credit for their achievements to male colleagues, friends or relatives. Consequently, over the centuries the Matilda effect has cancelled women scientists from history. This "invisibility" has led to the idea, which is still firmly entrenched, that science is something for men. As such, the gender of an author in a scientific field, as well as the topic of their research, may affect evaluations of the quality of their scientific research.

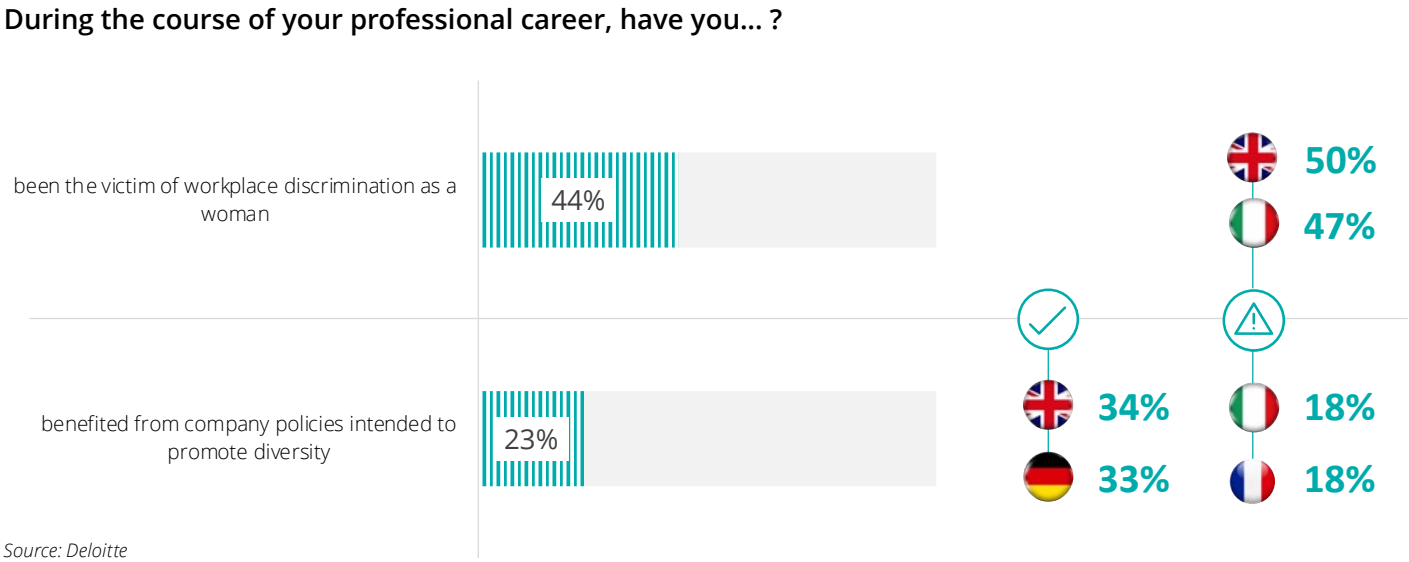
The lack of adequate female role models in science and technology is particularly detrimental. The gender of an academic adviser has an impact on girls' decisions. Female students assigned to female advisers from science departments are more likely to enrol in STEM majors later on and graduate with STEM degrees, compared to male students whether their advisor is male or female (Canaan and Mougaine, 2021).

Lack of confidence in one's own abilities, which may disproportionately affect girls when compared with boys, has also been shown to significantly affect girls' performance in mathematical and scientific subjects, causing them to feel even less confident as a result (OECD, 2015). Among interviewed students, NEETs and workers, girls' confidence gap seems to be further fuelled by the opinion of that **family and school are fertile environments for biased opinions**.

Parents' gender stereotypes about mathematical ability can influence their perceptions of their children's abilities, which strongly impacts a child's decision to embark on quantitative education (Unicef, 2020). Despite its relevance across all the countries considered in this analysis, **only two out of ten European students and one out of ten workers and NEETs acknowledged the seriousness of this issue**.

EXHIBIT 24

Women's experience during their professional career



Source: Deloitte

The socio-economic gap as a barrier to equal STEM education opportunities

The environment in which the children grow up, parents' education, school and family support and economic conditions play a decisive role in shaping children's attitude towards STEM. Making STEM education affordable, inclusive and non-biased is essential to foster social progess and guaranteeing equity for all.

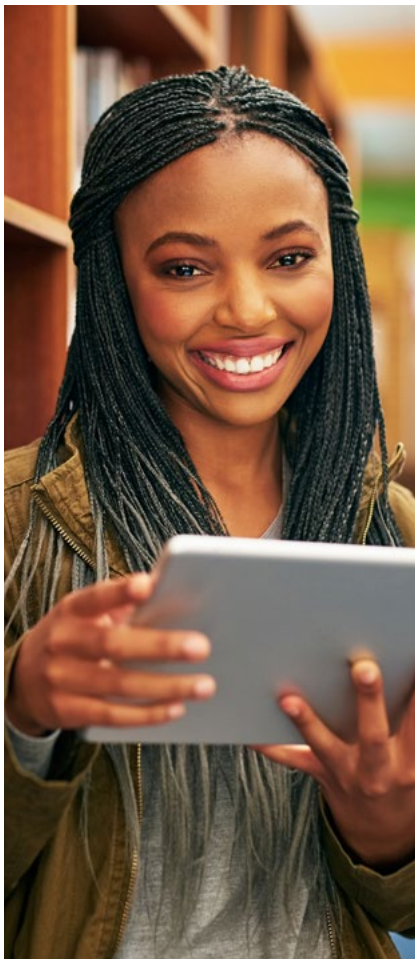
The key objective of the educational system is to enable equal opportunities - according to each individual's abilities and competencies - to access the highest levels of education. Regardless of their family background, every child has the right to see her or his potential developed. Nevertheless, **ensuring access to the highest levels of education, regardless of the economic and social status of children's parents, is still a challenge** for national educational systems in Europe.

Socio-economic conditions are another **source of disparities among STEM students**. The educational level of parents, as well as their socio-economic background, is a key factor in determining children's future wellbeing, economic standing and careers (Eurostat, 2020).

The environment in which children grow up plays an important role in shaping attitudes towards STEM education. In particular, **families are thought to play a determining role** in encouraging or discouraging them from pursuing STEM-related studies and careers. As reported by PISA (Programme for International Student Assessment) in 2015, a one-unit increase in the PISA Index of Economic, Social and Cultural Status resulted in an increase of 38 score points in science and 37 in mathematics. This may be related to parents providing additional learning support at school and at home, having higher academic expectations, and fewer traditional beliefs about gender roles and career paths in these settings.

Parents' education is also an important factor. Many studies in industrialised countries have shown that children of more highly educated parents take more mathematics and science courses in upper secondary education and perform better (OECD, 2018). PISA (2015) also revealed that, in mathematics for example, children aged 15 with less educated parents scored 453 on average in PISA tests, while those with highly educated parents scored 540.

Ethnicity, the language used at home, immigrant status and family structure may also have an influence on children participation and STEM performance. Some studies have found that children of immigrant parents and of single parents are more academically disadvantaged. PISA (2015) revealed that in the majority of the 35 participating countries first-generation and second-generation immigrant students tend to perform worse than their non-immigrant peers (OECD, 2018).



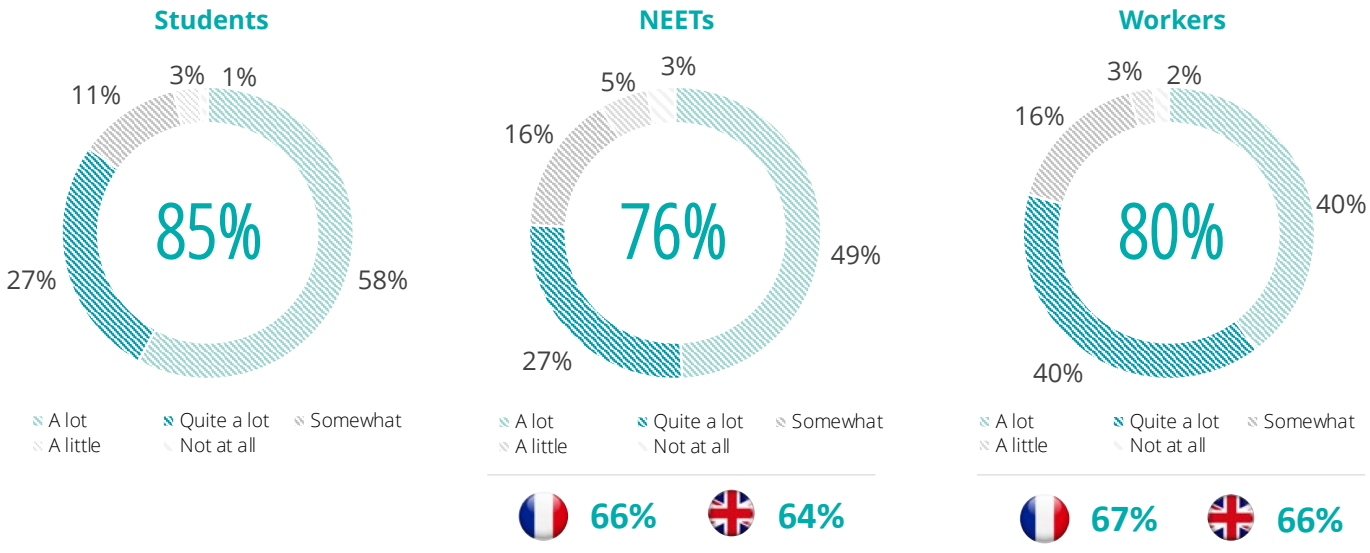
Social and economic measures that guarantee the right to study play a considerable role in determining the affordability and inclusivity of tertiary education. **Income and funding opportunities are a decisive factor in influencing student enrolment rates** in tertiary education. Degree cost acts as one of the main material deterrents in the decision to pursue a STEM degree.

This trend ultimately **exacerbates and reproduces existing inequalities**. If a child born into a disadvantaged family acquires less knowledge and fewer skills than his or her peers, he or she is more likely to experience economic hardship as an adult. The many factors that often affect the underperformance of children from disadvantaged families, include the stimuli received in the environment in which they grow up, family expectation, and the importance that parents attribute to education. Once young people reach working age, socio-economic inequalities regarding education and skills continue, which exacerbates the pre-existing skills gap. For example, participation in lifelong training reflects such inequalities.

Participation in training activities among low-skilled adults is particularly low, which leaves them caught in a "low-skills trap". Those with higher levels of basic skills proficiency are five times more likely to attend adult learning activities than low skilled individuals (OECD, 2017).

In this scenario, the Covid-19 pandemic has generally intensified inequalities, **increasing financial pressure on working students**, and making it more difficult for them to finance their studies. However, this is not the only consequence of the pandemic on European youth.

EXHIBIT 25
Financial support usefulness



Source: Deloitte

4 External impacts on STEM educational pathways

Two recent events that have changed the face of education are: the Covid-19 pandemic and Brexit.

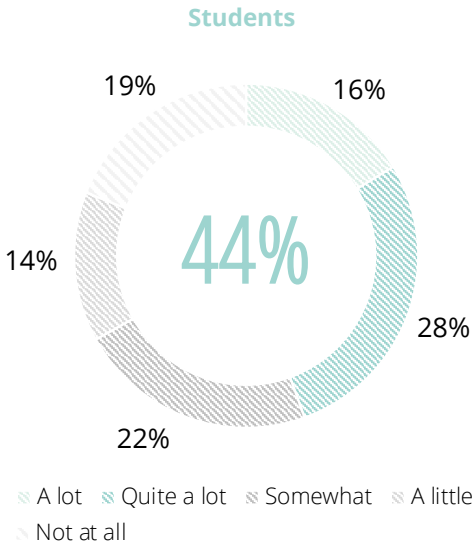
The main challenges facing prospective students have been connected with restrictions on mobility, and the reduced possibility for international and cultural exchanges.

Understanding the nature of these challenges will prove essential for the definition of appropriate measures to prevent disruptions in the provision of education in case of future external harmful events, as well as for focusing the attention of policymakers on the extent to which political decisions such as Brexit may have negative implications for the fruition of education by European youth.

How Covid-19 has changed the face of education

As one of the consequences of the 2020-2021 downturn, many young European graduates have dealt with mental health issues and the loss of job opportunities.

EXHIBIT 26
Impact of pandemic on the choice of academic path according to students

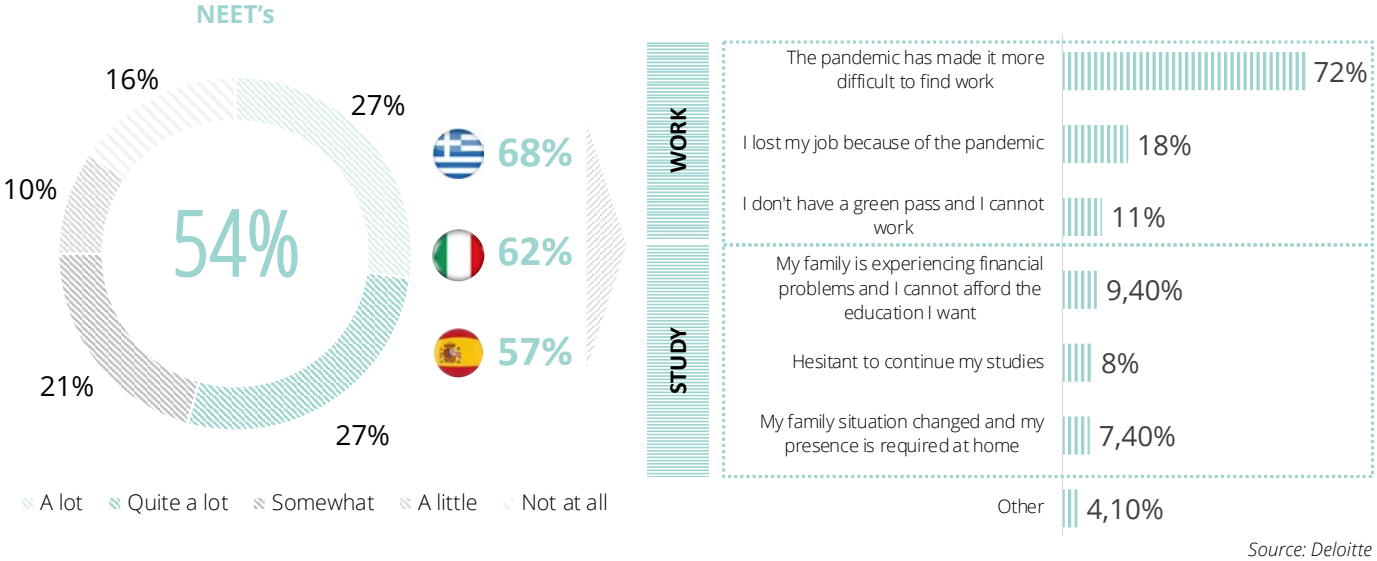


Source: Deloitte

Young people were affected greatly by the 2020-2021 downturn. Confronted with the shutdown of the job market, many young European graduates have been left alone to deal with mental health issues and the loss of job opportunities.

The pandemic has severely impacted students' access to educational opportunities. Although Covid-19 has not significantly influenced the enrolment rates of domestic students (European University Association, 2021), it has posed both short- and medium-term challenges to young learners. While in the short term the pandemic has primarily impacted studying conditions, access to funding and students' wellbeing, its medium-term effects will go as far as generating wider inequalities in accessing education (European Commission, Directorate-General for Education, Youth, Sport and Culture, 2021).

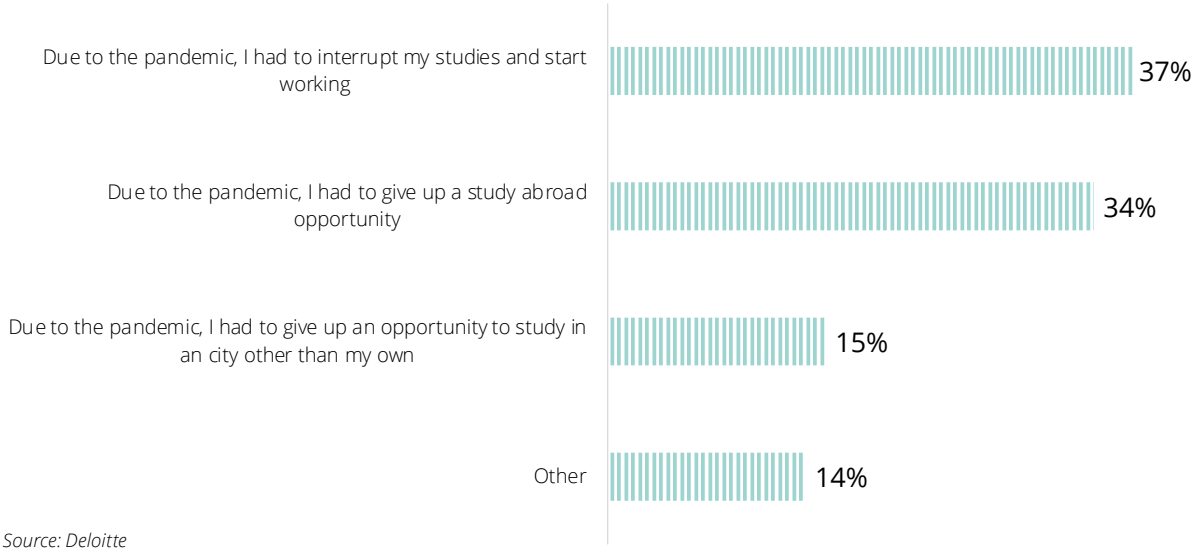
EXHIBIT 27
Impact of the pandemic on work/studies according to NEETs'



Source: Deloitte

EXHIBIT 28

Types of impact of the pandemic on studies



Source: Deloitte

Students and pupils have dealt with profound changes to the ways in which education is provided. During the peak of the pandemic, schools, universities and other educational institutions were forced to switch to distance learning.

According to data collected from interviews, students' reacted positively to distance learning, especially in Germany. Here, **more than half of the students interviewed reported that distance learning is a useful tool** for enhancing the learning experience in secondary schools and universities.

However, European secondary school students are not always enthusiastic about e-learning or distance learning, among others. Some of the weaknesses of distance learning mentioned by half of the students interviewed are with regards the lack of interaction with classmates.

Interviewed students reported difficulties experienced with distance learning, mainly due to infrastructural and equipment issues.

On average, just about **1** in **3 students (36%)** thinks that **distance learning** can be **useful** in secondary school.

In **Germany,** however, **half of students** agree on this.

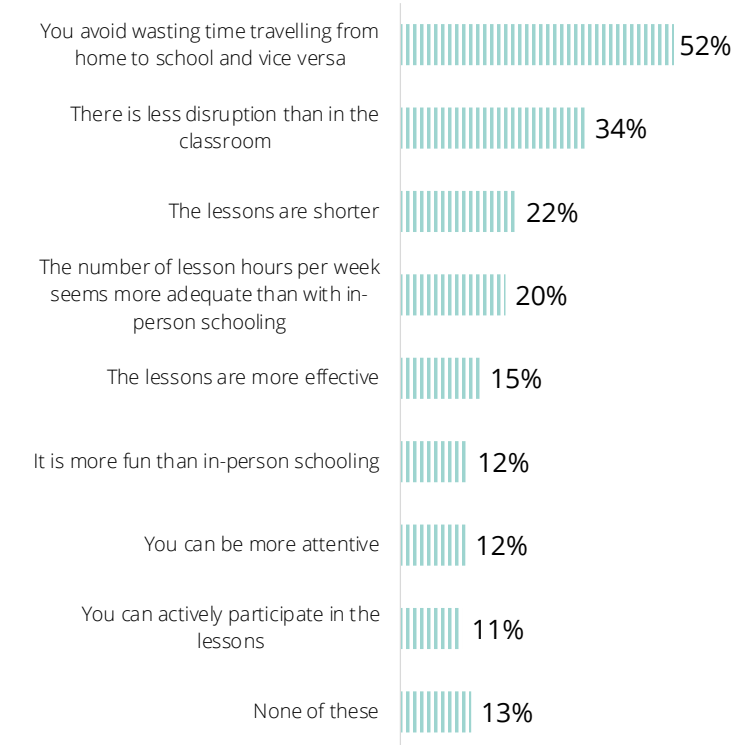
Some disadvantages are also commonly identified by secondary school students across various countries, such as potential distractions and the temptation to cheat, as well as the **lack of a personal relationship** with one's teachers and peers. Both issues are particularly strongly felt in Italy, by 53% and 64% respectively of the students interviewed.

Young people transitioning from school to university between 2020 and 2022 have been faced with new barriers to accessing education. In most of the countries considered, the pandemic was perceived by students as having a strong impact on the choice of their study path. This is the case for almost half of the respondents in Italy, Greece, Malta, Germany and the UK.

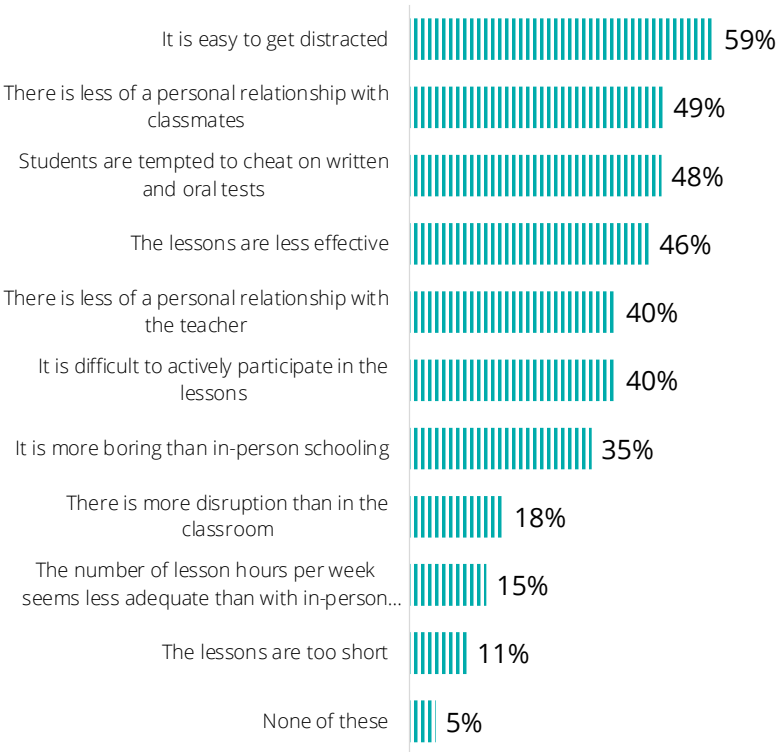
EXHIBIT 29

Strenghts and weaknesses of distance learning

STRENGHTS OF DISTANCE LEARNING



WEAKNESSESS OF DISTANCE LEARNING



Source: Deloitte

One significant challenge was the **decreased mobility** resulting from travel restrictions and lockdown measures widely implemented throughout 2020 and 2021. Besides international students taking part in exchange schemes during 2020, disruption to mobility continues to affect the general university population, making many students more uncertain about their plans (European Commission).

Greek and Italian NEETs are those most impacted by disruptions to mobility. Travel restrictions affect both students and a significant number of workers who are also forced to give up study opportunities abroad, **especially those in Italy and Greece**.

Finally, one major negative consequence of Covid-19 has been **the drastic reduction in job market opportunities**.

Decreased European mobility is a main consequence of travel restrictions and lockdown measures.

On average, the **pandemic** has had a significant impact on **about half (44%)** of students' choice of **academic path**.

Young people's mobility in the post-Brexit world

On 31 January 2020[1], the United Kingdom officially exited the European Union. **Brexit's repercussions on European students, workers and NEETs appear to be quite limited as of 2022**. Only around 9% of Spanish students admit being affected by it, while German students are considerably more impacted. The figures for NEETs are similar, although in this case southern European and British NEETs appeared to be more affected.

> British workers were those most affected by Brexit.

Workers have been slightly more impacted. Brexit-related restrictions have forced more than three in ten workers to change their plans to move away from their home country to study. British workers have been the most affected, with more than half of them experiencing barriers to their mobility. Italian business executives and HR specialists reportedly perceive that the United Kingdom might be losing its primacy as Europe's "innovation hub" in the eyes of younger professionals, despite still being deemed as a destination of excellence for students, especially for STEM disciplines.

Even though fees **for European students** are higher as they have been equalized with those for international students, together with new barriers to mobility, the number of European nationals studying in the UK has continued to grow in recent times. In 2021, there were almost 153,000 international European students at British universities, approximately 15,000 more than in 2016. Against this backdrop, **in 2020 Italy was the country with the most international students in the UK, and the number of Italian expats even rose slightly but steadily compared to previous years**. Data on the impact of Brexit on STEM students show a reduction in exchange programs, which poses a significant obstacle to the free movement of scientific and technological human capital between continental Europe and the UK.

> The reduction in exchange programs between continental Europe and the UK is an obstacle to the free movement of scientific and technological talent.

About half of

50% students

44% NEET's

say their studies were affected in terms of **moblity**

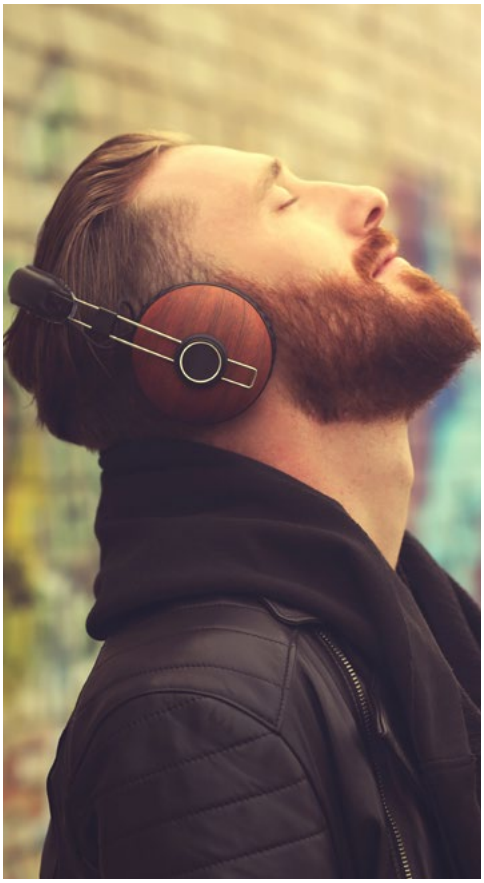
[1] *While the decision was taken for the first time by the Brexit referendum in 2016, Prime Minister Theresa May only formalized the result before the European Council in 2017; the formal withdrawal agreement wasn't ratified until 2019.*

5 STE(A)M education nurturing a resilient future generation

The education system is strongly influenced by the consequences of the recent Covid-19 pandemic, as well as by growing inequalities and climate change. However, it should be pointed out that the future is full of opportunities as well as challenges.

STEM education should be considered apart from other disciplines, and it is also clear that the future of education will increasingly depend on the integration of quantitative and humanistic knowledge. Therefore, the topic of skills hybridization is vital for exploring ways in which future scientific skills will interact with humanistic skills, resulting in the creation of new profiles that are broader, more dynamic and better suited to the future evolution of the job market.

In this context, STE(A)M caters to the need for "polymath" profiles to tackle the big challenges of our times. **STE(A)M is a variant of the acronym STEM, to which an "A" for arts and humanistic disciplines (literature, arts, social sciences, history, philosophy, linguistics) has been added.**



STEM skills for the climate transition

When surveyed on their interest in sustainability, students were generally more interested in working in the sustainability sector than NEETs, with Maltese Neets (38%) showing the highest level of concern about sustainability.

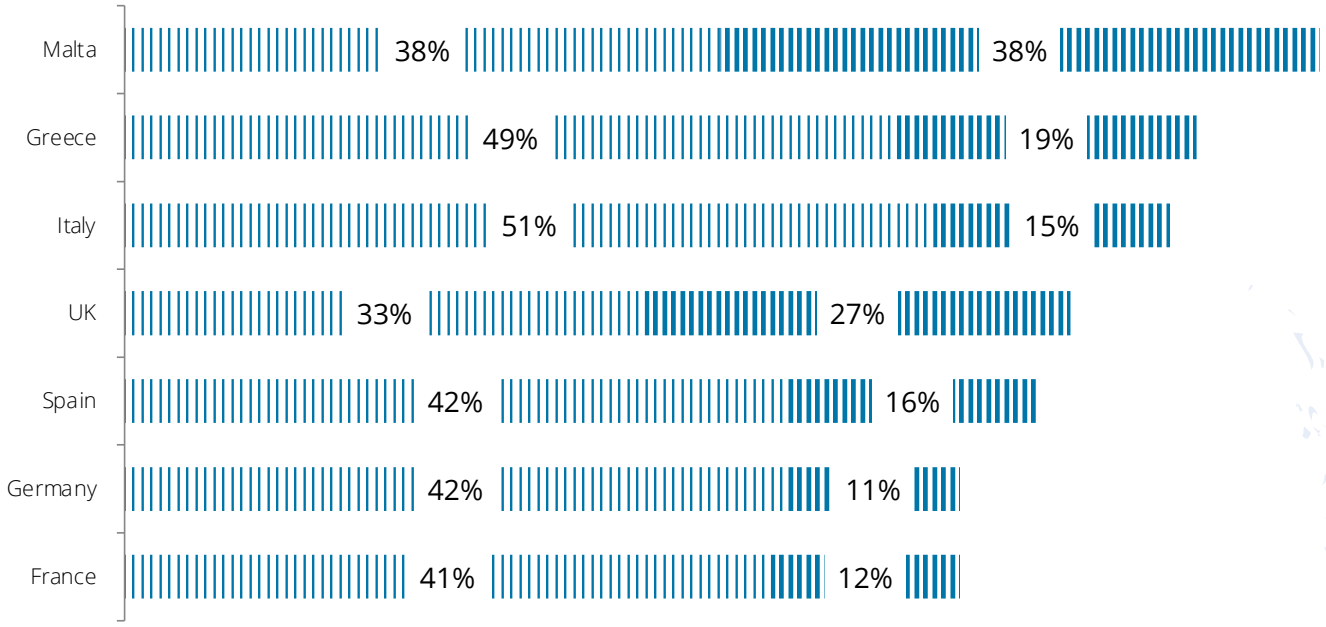
89% of interviewees in this group were either not interested in the topic or unable to form a clear opinion about it. However, **the vast majority of respondents confirmed the belief that STEM skills can be useful for anyone who wants to work in sustainability**.

> STEM skills represent a great opportunity to counter climate change.

This sentiment is largely shared by representatives of European higher education institutions. Many interviewees in this target group voiced the idea that STEM fields equip students with the right **tools and knowledge to use technology to support the fight against climate change**.

EXHIBIT 30

STEM as a means for working in the sustainability sector according to students



Source: Deloitte

The path to skills hybridization: the promise of the STEAM approach

The **STEAM** approach is championed by the European Commission as a way to encourage students to contextualize STEM subjects in the wider political, cultural and social landscape (European Commission). The main vision of promoters of STEAM education is to gradually eradicate barriers between scientific education and the humanities, the arts and social sciences. From the perspective of students and learners, STEAM education, as opposed to traditional STEM education, could be effectively leveraged to foster these transversal soft skills, that support the social and environmental transition to a sustainable and equal balance. It could also encourage girls to participate in science and technology fields.

Scientific skills together with humanistic skills will create new more suitable profiles for the future by humanistic skills to create new more suitable profiles for the future.

STEAM Education is an approach to learning that uses **Science**, **Technology**, **Engineering**, the **Arts & Humanities**, **Mathematics** as access points for guiding student inquiry, dialogue, and critical thinking. Integrating concepts, topics, standards and assessments is a powerful way to disrupt the typical learning, while creating new approaches that allow the development of adaptive and hybrid skills.

Although there is still little empirical research on the effect of STEAM education, partly due to the lack of a unified framework for a STEAM approach to education or for the creation of interdisciplinary degrees (Steam Education in Europe, 2018), some preliminary results are encouraging. For example, according to research presented at the FabLearn Conference 2020 in Bangkok, adopting a STEAM approach to teaching **can help improve data literacy among high school students** (2nd Foundation: Maker Skills, Design Thinking and Electronics for Children).

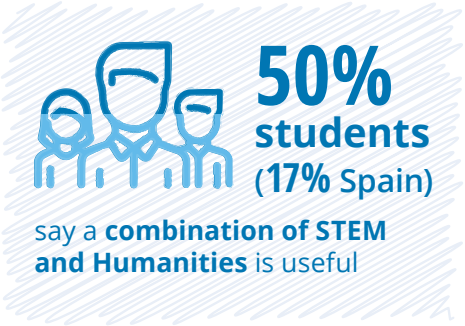
Overall, both young Europeans (students, NEETs and workers) and employers appear to appreciate the idea of combining STEM with humanities and art subjects.

Greek employers were the most knowledgeable about STEAM subjects and skills hybridization, and they were also the most convinced about the increasing relevance of STEAM education for the workforce of the future, with only 4% of them dissenting from this opinion.

By bringing closer together subjects that have historically been considered as belonging to completely different realms, STEAM education can benefit students and also be leveraged as a means for promoting STEM subjects. However, this development is also relevant for the big trends of our times, which have led to the need to create **unconventional professional profiles**, namely those which are no longer merely tied to courses of study, but rather are the outcome of cross-fertilization of several different skills.

A prime example of the rise of new fields of study are the so-called Digital Humanites. This **diverse and still emerging field** explores the intersection between traditional humanities subjects - such as philosophy, literature and languages - and technology, media and computational methods.

EXHIBIT 29
Usefulness of STEAM approach according to students



Source: Deloitte

The STEAM approach fosters transversal skills that are more relevant in the resolution of challenges at both European and global level market by eradicating barriers between science education and the humanities, the arts and social sciences.

In recent years, the digital humanities have developed significantly via four streams: increased research funding; new fields of study; more postgraduate courses for graduate students (master's and doctoral degrees, for example); and an increase in the production of articles, monographs and essays.

How can STEAM be a tool for promoting resilience to the challenges that lie ahead of us? To make these disciplines truly effective to tackle today's challenges and to fill existing gaps, potential policies, best practices and strategies need to be outlined. To find potential solutions, relevant ecosystem actors such as - schools, universities, policy makers as well as private businesses and no-profit organizations - could both benefit and achieve social progress through hybrid (STEAM) education.

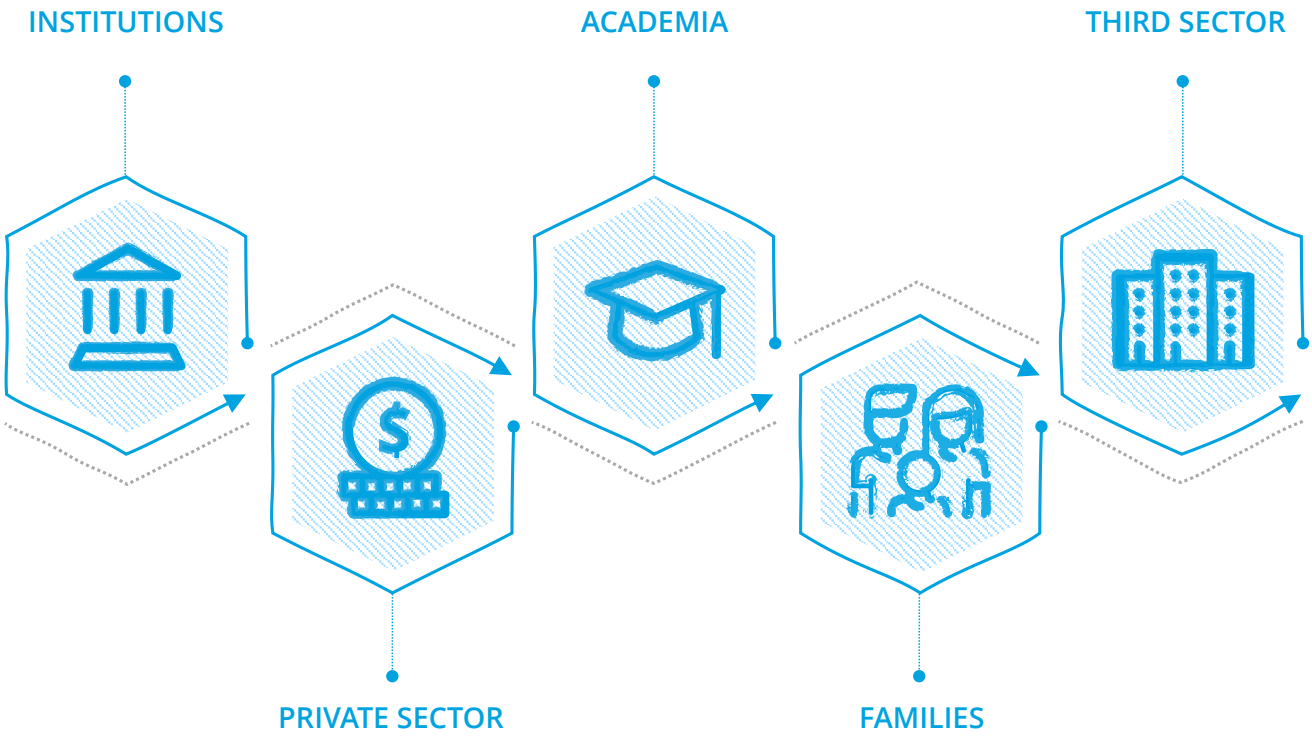
6 Leading change through STEAM

One team: three actions for change

To rethink STE(A)M education, key agents of change must lead the way. Institutions, academia, the private sector, families and the third sector are key enablers in the development of concrete solutions to advance social progress, delivering equity in and through STEM.

The potential actions for change presented are part of a broad call to action to everyone in the position to make a difference in providing youth with the hybrid skills required to tackle the challenges of tomorrow.

Through this report, Deloitte invites everyone who is in the position to make a difference to lead the change towards a more sustainable and equal path in education. As such, a joint committiment will foster the debate and develop potential paths of cooperation, building the ground to re-think STEAM education.



Three actions for change

This study has focused on a variety of issues that prevent people from embarking on a STEM career. Based on the data collected and examined in this study, possible actions of change can be taken.

Existing framework and strategies on education are explored, with the objective of addressing potential issues and areas of action hereby presented.

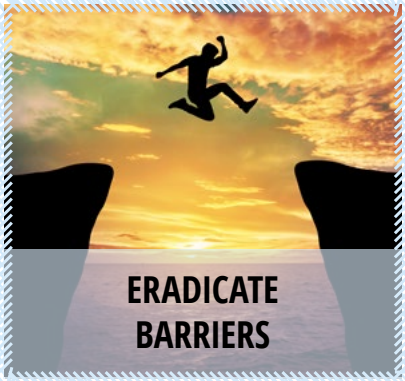
The first issue considered is the perception of STEM, touching on the misconceptions surrounding STEM skills and competencies that preclude young people's interest in these subjects.

Secondly, as the report has shown, gender and socio-economic barriers to pursuing a STEM career need to be addressed, in order to guarantee sustainable development.

Finally, one of the most pressing issues in today's job market, including the third sector, is the lack of **STEM and advanced digital skills**, which severely hampers access to future job opportunities in Europe.

In light of the above-mentioned issues, three actions of change may represent viable ways to foster social progress through STEM:

- **Broaden STEM knowledge**
- **Eradicate barriers**
- **Rethink Talent**.



Broaden STEM knowledge

First action for change

Awareness of STEM and its relevance in tackling today's challenges is essential when making a career choice. Unfortunately, there is a general lack of recognition of the importance of STEM education, as well as scant awareness of the job opportunities open to someone with a STEM background.

Moreover, **stereotypical attitudes to STEM** are also widespread. STEM subjects are perceived as being more difficult than non-STEM subjects, and require hard skills possessed only by a few, thus reinforcing the commonly held opinion that they are only suited to some people. Such categories do not include women, as there is also an underlying popular belief that these studies are not suitable for women.

To counter stereotypical attitudes to STEM subjects, it is important that both boys and girls come across STEAM education from an early age at school and at home. As stereotypes take root in the early years of childhood, families and teachers should provide young learners with an initial approach to these subjects, regardless of their gender or social class. **Initiatives that promote education on the relevance of new STEM profiles** can potentially spark interest among young learners, just like initiatives that raise awareness of STEM subjects are vital for connecting students with their families and teachers.

Finally, improving awareness is also fundamental for providing students with the adequate support they need to make an informed decision during the transition from school to university. In this context, families and schools - who are the main sources of **support for students transitioning from school to university** - are also often unaware of opportunities in this field, or may contribute to a stereotypical view of STEM graduates.

PROPOSED ACTIONS

Unveiling STEM data

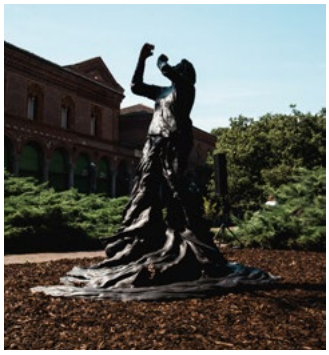
Improve data accessibility by promoting the creation of **centralized datasets and synthetic indices** at European and national level. Data disaggregation at national as well as regional and municipal level is a barrier to achieving STEM awareness and to the development of adequate measures and policies regarding STEM.

Creating a bridge between STEM and society

Spread knowledge about STEM disciplines and professions via **the arts, cinema and the media**, leveraging the use of public art as a teaching platform to raise awareness and make the invisible visible. Promote new approaches to STEM via the use of **non-biased textbooks in primary schools**, with a view to increasing social equality and providing a clear outlook of what the STEM world could be.

Connecting students and teachers

Create a **platform designed for students and teachers** at European level to facilitate and develop sharing of experiences, knowledge and STEM competencies. The platform would also include promotion of courses in collaboration with research centres, universities and private sector businesses, and be addressed to all school teachers, so that they may develop a non-biased attitude towards STEM disciplines. Far-fetched professions, such as astronaut and Nobel-prize-winning physicist should be steered away from, and the focus shifted towards video game developers, entrepreneurs, and data professionals.



Role modeling through the use of arts in Italy

On the occasion of the centenary of astrophysicist Margherita Hack's birth the Municipality of Milan inaugurated on June 2022 the first sculpture on public ground dedicated to a woman of science in Italy.

The sculpture, donated by Fondazione Deloitte, has been installed in Largo Richini in the square facing the Università Statale. By increasing and improving the presence of women in STEM in the media, arts and public spaces, a non-biased and inclusive view of STEM is promoted, aimed at inspiring and supporting youth in their future educational choices.

Eradicate barriers

Second action for change

Guaranteeing equal opportunities for the next generation is fundamental to the achievement of social and environmental sustainability. Unfortunately, gender and cultural barriers are a major **obstacle to achieving inclusiveness in STEM**, at the core of the scarce participation in these disciplines. To make STEM inclusive and unveil individuals' potential, barriers have to be broken down.

The nature of these barriers is rooted in societies' values and beliefs, making them extremely difficult and urgent to tackle at the same time. As **cultural norms, initiatives and measures that foster inclusiveness and diversity** play a fundamental role in the learning and development processes of the child, it is essential that actions aimed at reducing the **gender and socio-economic gap** are taken.

PROPOSED ACTIONS

Unlock equal opportunities to girls and women

Promote the presence of girls in STEM funding projects that include **role modelling and increased representation of female STEM professionals in the media and in public spaces**. Introduce female STEM professionals to girls in primary schools, so that they can interact with real-life mentors who could inspire and support them in their future educational choices. Foster dialogue with enterprises to **make sure that female presence** within a company's STEM-related profession is valued. Encourage girls' participation in STEM disciplines at universities via study support measures, scholarships and orientation initiatives.

Guarantee the right to STEM education for all citizens

Support **inclusive access to university, housing and future job opportunities**. Support students with lower socio-economic status by strengthening distance learning, increasing provision of, and improving, infrastructure in isolated communities. Facilitate dialogue with people in isolated / disadvantaged communities through ICT technologies.

Engage students with STEM

Promote **interactive learning at school and beyond**, by using labs, coaching with STEM mentors and professionals, science camps, coding camps and hackathons to leverage students' vocation for STEM, and improve students' engagement with scientific and technical knowledge in disadvantaged communities. By shifting the focus towards a **more applied and hands-on approach in schools**, students feel more involved in the creative process rather than simply learning about theory. Leveraging their voices and experiences in the classroom can help to better convey what is being learnt, enhancing students' sense of engagement and inclusion.

Girls in STEM

The aim of this project, **funded by the European Commission through the Erasmus+ programme**, is to empower girls to pursue their interests in Science, Engineering, Technology and Maths subjects (STEM), providing them with positive examples, support and possibilities to experience STEM occupations. Through this initiative, girls will realise that they are supported to embark on a fulfilling and successful career in STEM.

Rethink talent
Third action for change

Recent global events have been radically transforming the skills and talent that communities and organizations need to thrive. As widely explored, the **future of work will require the upskilling and reskilling** of more than one billion people by 2030 globally. Jobs are transformed by digital technology, but high-tech skills are not the only ones in high demand.
Specialized interpersonal skills, including those relating to sales, human resources, care, and education, will be core demands for businesses.

In this context, the **development of new, hybrid and transferrable skills** will enable people to address recent societal and environmental shifts. Equipping students with key transversal skills has never been more important, given the **great challenges of the climate change era**. To this end, the **STEAM approach** represents an opportunity to change the education paradigm towards a more sustainable way of learning. To ensure that people are not left behind in this transition, governments, businesses and society ought to cooperate to provide education, skills and jobs for the future generation.

PROPOSED ACTIONS

Promote non-formal, hybrid and macro-credential educational pathways

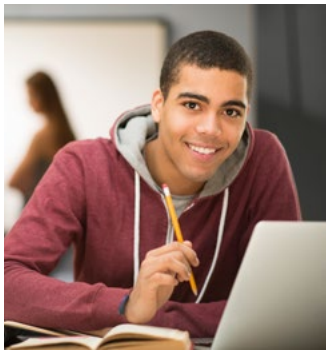
Promote **STEAM high school and university courses** to enable students to develop hybrid and transversal skills, that offer the possibility of choosing **ad-hoc academic paths**. Encourage the development of **non-formal educational pathways**, via information campaigns to promote lifelong learning among the general population, thereby reducing the stigma of non-formal learning. Promote **macro-credentials** as an alternative to formal education: learning complete, high-quality, career-advancing programs from home, without having to step away from work or family obligations. Explore a variety of alternatives including competency-based degrees, certificates, badges, micro credentials, and/or recognition of credentials from MOOCs (Massive Open Online Courses).

Close the skills gap and reskill talents

Monitor any potential skills gap via an annual **survey** to keep universities and enterprises connected and up to speed regarding high-demand competencies and professions, in order to provide a regularly updated outlook on major shifts in the labour market. Extend university offerings for the purposes of **reskilling and lifelong learning**, including implementation of more high-quality flexible degree options, online degrees and specialization courses led by institutions of excellence.
Encourage businesses to upskill and reskill workers, as companies will play a major role in reskilling.

Build STEAM competencies

Promote ongoing **cooperation between universities and enterprises via concrete job opportunities for students** aimed at acquiring **new hybrid skills** that make the difference in **tackling global challenges**. Encourage the creation of projects and laboratories that encourage students to apply STEAM subjects, such as mathematical, ICT and scientific knowledge, to tackling important social and environmental issues, and/or to foster cultural output (art, music, architecture and design). Encourage the establishment of apprenticeships systems and ensure that apprenticeships systems respond to changing professions and include the latest technology in learning tools.



German model of Dual Degree and Italy follows

Dual study programs in **Germany** are a great opportunity for students to integrate academic theoretical learning with practical work experiences. Dual studies refers to a mode of studies that combines work & study by integrating vocational training or work placements with academic training. Furthermore, students get paid with a fixed salary throughout their dual studies. In 2022 **Italy** allowed students to attend two degrees at the same time both bachelors or master degrees, approving in the Parliament the so called “Doppia Laurea”.

Methodology

The study addressed five main target groups: students, employed and unemployed young people aged between 16 and 34, businesses representatives and faculty members from a number of European higher education institutions. The research design involved the deployment of a mixed method approach, namely use of a diverse toolbox of survey and data analysis tools, divided into two main categories: quantitative structured surveys, and qualitative interviews. This approach was adopted to best capture the characteristics of the samples involved in the study, as well as the specific research question identified in the design phase.

Overall, 2,650 interviews were conducted in the quantitative phase and 26 in-depth interviews in the qualitative phase.

The samples used for the quantitative analysis were balanced across their geographic location, and included individuals with STEM and non-STEM backgrounds.

Quantitative surveys of students, workers and NEETs involved 2,500 respondents from seven European countries: Italy, Greece, Malta, Spain, France, Germany and the UK. The 15-minute interviews were conducted in accordance with the computer-assisted web interview (CAWI) method between 14 December 2021 and 31 March 2022. Surveys of employers were conducted in accordance with the computer-assisted telephone interview (CATI) method between December 2021 and January 2022. The sample comprised 150 interviewees evenly distributed among the three countries considered: Italy, Malta and Greece.

Qualitative interviews saw the participation of 20 respondents from the academic world, including lecturers, representatives, guidance counsellors and administrative personnel from Italy, Greece, Malta, Spain, France, Germany and the UK, as well as five executives from the strategic and HR divisions of some of the largest Italian industrial groups: Menarini, Pirelli, Novartis, Sanofi and E-ON. The data collection method adopted used in-depth, one-to-one, unstructured interviews. The purpose of the qualitative analysis was mainly to corroborate, extend and identify a potential causal underpinning for the findings revealed during the quantitative interviews, but also to highlight the perspective of key actors in the university ecosystem.

The quantitative and the qualitative surveys spanned across a series of macro-themes, primarily including:

- The impact of the pandemic on the studies and professional choices of young people studying STEM subjects, as well as on the implementation of distance learning systems. A particular focus was placed on the transition phases. In this regard, the role of three main players have been analysed: institutions, family members, and external (non-institutional) educators and instructors.
- The deterrents and barriers to embarking on STEM education. These included income, expenses, the pandemic-related digital divide, dropout students no longer able to work and support themselves, and the impact of Covid-19.
- The drivers of choice of STEM-related educational pathways.
- The relationship between STEM subjects and careers in sustainability.
- Employers' difficulties in finding workers specialized in STEM subjects.
- The topic of non-formal education. In the formulation of survey questions aimed at employers, a distinction was drawn between non-university master's and training courses, and boot camps and academies.
- The STEM gender gap. To shed light on this complex topic, particular attention was paid to the persistence of gender-based discrimination patterns in the job market, the family environment and the school context.
- The impact of travel restrictions on intra-European mobility caused by Brexit and Covid-19.
- Skills hybridization and the potential evolution of the STEAM paradigm.
- The potential contribution of young STEM graduates to the transformation of the third sector.

TARGET	TARGET DETAIL	METODOLOGY	IT	EL	MT	ES	UK	FR	DE
STUDENTS	High School 4-5 yrs	CAWI (computer-assisted web Interview)	300	100	100	100	100	100	100
	University								
WORKERS 25-35 yrs	Degree		300	100		100	100	100	100
	No degree								
NEETs 18-24 yrs 25-35 yrs			300	100		100	100	100	100
UNIVERSITY	Professors	1:1 in-depth interviews	8	2	3	2	2	2	1
	Senior directors (rectors, heads of careers, etc).								
ENTERPRISES	HR department/ others	CAW/CATI (computer-assisted web/telephone Interview)	50	50	50	n.d.	n.d.	n.d.	n.d.
		1:1 in-depth interviews	7	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

Sources

BRUN-SCHAMMÉ, A. & REY, M. 2021. A new approach to skills mismatch.

CEDEFOP (2018). Insights into skill shortages and skill mismatch. Learning from Cedefop's European skills and jobs survey. [online] Available at: https://www.cedefop.europa.eu/en/publications/3075#group-related [Accessed 13 Mar. 2022].

European Commission (2021). COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS 2030 Digital Compass: the European way for the Digital Decade. Available at: https://ec.europa.eu/info/sites/default/files/communication-digital-compass-2030_en.pdf.

European Commission (2010). COMMUNICATION FROM THE COMMISSION EUROPE 2020 A strategy for smart, sustainable and inclusive growth. Available at: https://op.europa.eu/en/publication-detail/-/publication/6a915e39-0aab-491c-8881-147ec91fe88a/language-en.

European Commission, Directorate-General for Education, Youth, Sport and Culture, (2016) Does the EU need more STEM graduates?: final report. Publications Office. Available at: https://data.europa.eu/doi/10.2766/000444 [Accessed 13 Mar 2022].

European Commission, Directorate-General of Communications Networks, Content and Technology (2021). International Digital Economy and Society Index 2020. [online] Available at: https://ec.europa.eu/info/departments/communications-networks-content-and-technology/what-we-do-communications-networks-content-and-technology_en.

European Commission, Directorate-General for Budget, (2021) The EU's 2021-2027 long-term budget and NextGenerationEU: facts and figures. Available at: https://data.europa.eu/doi/10.2761/91357 [Accessed 13 Mar 2022].

European Commission (2021). (n.d.). Education and Training Monitor 2021. [online] Available at: https://ec.europa.eu/info/events/2021-education-and-training-monitor_en.

European Commission, Directorate-General for Research and Innovation, (2021) She figures 2021: gender in research and innovation: statistics and indicators. Publications Office. Available at: https://data.europa.eu/doi/10.2777/06090 [Accessed 13 Mar 2022].

European Commission, Directorate-General for Education, Youth, Sport and Culture, Farnell, T., Skledar Matijević, A., Šćukanec Schmidt, N. (2021) The impact of COVID-19 on higher education: a review of emerging evidence: analytical report. Publications Office. Available at: https://data.europa.eu/doi/10.2766/069216 [Accessed 13 Mar 2022].

European Commission - European Commission. (n.d.). Press corner. [online] Available at: https://ec.europa.eu/commission/presscorner/home/en.

European Fundraising Association (2017). FUNDRAISING IN EUROPE A brief exploration of the European charity fundraising environment, based on a survey of EFA's members: 15 national fundraising association representatives. [online] Available at: https://efa-net.eu/wp-content/uploads/2018/10/EFA_Fundraising_in_Europe_Report_Dec_17.pdf [Accessed 13 Mar 2022].

European Science Foundation and Science Connect (2017). 2017 Career Tracking Survey of Doctorate Holders, Project Report. [online] Available at: https://www.esf.org/fileadmin/user_upload/esf/F-FINAL-Career_Tracking_Survey_2017__Project_Report.pdf [Accessed 13 Mar 2022].

European Parliament, Directorate-General for Internal Policies of the Union, Picarella, F., Konle-Seidl, R. (2021) Youth in Europe: effects of Covid-19 on their economic and social situation. European Parliament. Available at: https://data.europa.eu/doi/10.2861/188063 [Accessed 13 Mar 2022].

Eurostat, 2021. Early leavers from education and training - Statistics Explained. [online] Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Early_leavers_from_education_and_training.

Eurostat, 2021. ICT specialists in employment. [online] Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=ICT_specialists_in_employment.

Eurostat, 2020. Living condition statistics - family situation of today's adults as children. [online] Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Living_condition_statistics_-_family_situation_of_today%27s_adults_as_children&oldid=231142 [Accessed 13 Mar 2022].

Eurostat, 2020. Tertiary education statistics. [online] Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Tertiary_education_statistics.

European Education and Culture Executive Agency, Eurydice, Krémó, A. (2020) National student fee and support systems in European higher education : 2020/21. Publications Office. Available at: https://data.europa.eu/doi/10.2797/774855 [Accessed 13 Mar 2022].

European Youth Foundation. (n.d.). Definitions. [online] Available at: https://www.coe.int/en/web/european-youth-foundation/definitions. [Accessed 13 Mar. 2022].

European Youth Forum and People, Dialogue and Change (2021). Beyond Lockdown: The "pandemic scar" on young people. The social, economic and mental health impact of Covid-19 on young people in Europe. [online] Available at: https://tools.youthforum.org/policy-library/wp-content/uploads/2021/07/European-Youth-Forum-Report-v1.2.pdf [Accessed 13 Mar 2022].

European University Association (2021). The impact of Covid-19 on European higher education. [online] Available at: https://eua.eu/downloads/publications/the%20impact%20of%20covid-19%20on%20european%20higher%20education.pdf [Accessed 13 Mar 2022].

Gallagher, S. and Palmer, J. (2020). The Pandemic Pushed Universities Online. The Change Was Long Overdue. [online] Harvard Business Review. Available at: https://hbr.org/2020/09/the-pandemic-pushed-universities-online-the-change-was-long-overdue.

Higher Education Statistics Agency (2017). Where do HE students come from? | HESA. [online] Hesa.ac.uk. Available at: https://www.hesa.ac.uk/data-and-analysis/students/where-from.

IPCC (2021). Sixth Assessment Report. [online] www.ipcc.ch. Available at: https://www.ipcc.ch/report/ar6/wg1/.

JAMES JACOB, W. 2015. Interdisciplinary trends in higher education. Palgrave Communications, 1, 15001.

KOLIOUSKA, C. & ANDREOPOULOU, Z. 2020. A Multicriteria Approach for Assessing the Impact of ICT on EU Sustainable Regional Policy. Sustainability, 12, 4869.

MUENKS, K., CANNING, E. A., LACOSSE, J., GREEN, D. J., ZIRKEL, S., GARCIA, J. A. & MURPHY, M. C. 2020. Does my professor think my ability can change? Students' perceptions of their STEM professors' mindset beliefs predict their psychological vulnerability, engagement, and performance in class. Journal of Experimental Psychology: General, 149, 2119-2144.

NAGARAJAN, A., MINCES, V., ANU, V., GOPALASAMY, V. & BHAVANI, R. R. 2020. There's data all around you: Improving data literacy in high schools through STEAM based activities. Fablearn Asia 2020.

NAHRKHALAJI, S. S., SHAFIEE, S., SHAFIEE, M. & HVAM, L. Challenges of Digital Transformation: The Case of the Non-profit Sector. 2018 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), 16-19 Dec. 2018 2018. 1245-1249.

OECD (2019). OECD work on careers of doctoral holders. [online] Available at: https://www.oecd.org/innovation/inno/careers-of-doctorate-holders.htm [Accessed 13 Mar 2022].

OECD (2018). BRIDGING THE DIGITAL GENDER DIVIDE. INCLUDE, UPSKILL, INNOVATE. [online] Available at: https://www.oecd.org/digital/bridging-the-digital-gender-divide.pdf [Accessed 13 Mar 2022].

OECD. (n.d.). Young people and women hit hard by jobs crisis. [online] Available at: https://www.oecd.org/coronavirus/en/data-insights/the-pandemic-has-not-improved-things-for-women [Accessed 13 Mar 2022].

OECD (2018). PISA 2015: Results in Focus. [online] Available at: https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf [Accessed 13 Mar 2022].

STEAM Education in Europe: A Comparative Analysis Report. (n.d.). [online] Available at: https://www.stemnetwork.eu/wp-content/uploads/sites/14/2020/09/STEM-Education-in-Europe-a-Comparative-Analysis-Report-Erasmus.pdf.

The European Institute for Gender Equality (2018). Study in the EU: set apart by gender. [online] Available at: https://eige.europa.eu/news/study-and-work-eu-set-apart-gender.

The World Economic Forum (2020). The Future of Jobs Report 2020. [online] Available at: https://www.weforum.org/reports/the-future-of-jobs-report-2020 [Accessed 13 Mar. 2022].

The World Economic Forum (2020). The Global Social Mobility Report 2020. [online] Available at: https://reports.weforum.org/social-mobility-report-2020/ [Accessed 13 Mar 2022].

UNESCO, Director General (2017). Cracking the code: girls' and women's education in science, technology, engineering and mathematics (STEM). [online] Available at: https://unesdoc.unesco.org/ark:/48223/pf0000253479.

UNESCO (2021). Women in higher education: has the female advantage put an end to gender inequalities? [online] Available at: https://unesdoc.unesco.org/ark:/48223/pf0000377182 [Accessed 13 Mar 2022].

UNICEF (2020). Mapping gender equality in STEM from school to work. [online] Available at: https://www.unicef.org/globalinsight/stories/mapping-gender-equality-stem-school-work.

Vedung, E. (1998). Policy instruments: Typologies and theories. In M. L. Bemelmans-Videc & R. C. Rist (Eds.), Carrots, sticks, and sermons: Policy instruments and their evaluation (pp. 103–128). New Brunswick, NJ: Transaction Publishers.

VELDMAN, J., VAN LAAR, C., THOMAN, D. B. & VAN SOOM, C. 2021. "Where will I belong more?": The role of belonging comparisons between STEM fields in high school girls' STEM interest. Social Psychology of Education, 24, 1363-1387.

Contacts

FABIO POMPEI
CEO
Deloitte Central Mediterranean
fpompei@deloitte.it

GIANMARIO CRESCENTINO
Chairman &
Public Policy Leader
Deloitte Central Mediterranean
ggrescentino@deloitte.it

GUIDO BORSANI
President
Deloitte Italian Foundation
Deloitte Central Mediterranean
Public Services Leader
guborsani@deloitte.it

ALESSANDRO DE LUCA
Partner
Public Policy Leader
Deloitte Italy
aldeluca@deloitte.it

VASSILIS KAFATOS
Partner
Public Policy Leader
Deloitte Greece
vkafatos@deloitte.gr

MICHAEL ZARB
Partner
Public Policy Leader
Deloitte Malta
mzarb@deloitte.com.mt

BARBARA TAGLIAFERRI
Director
Deloitte Central Mediterranean
Brand & Communications Leader
Direttore operativo Fondazione
Deloitte
btagliaferri@deloitte.it

MARIANGELA CAMPALANI
Director
Clients & Industries
Deloitte Central Mediterranean
mcampalani@deloitte.it

ANA VICTORIA ARRUABARRENA
Manager
Public Policy Program
Government & Public Services
Deloitte Italy
aarruabarrena@deloitte.it

CHRISTOS THEOCHAROPOULOS
Principal
Deputy Public Policy Leader
Deloitte Greece
ctheocharopoulos@deloitte.gr

ADRIAN MAMO
Senior Manager
Public Policy Program
Deloitte Malta
admamo@deloitte.com.mt

Research and Editorial

GIADA PEDEMONTE
Staff
Public Policy Program
Deloitte Central Mediterranean
gpedemonte@deloitte.it

MARIA VITTORIA RICCI
Staff
Public Policy Program
Deloitte Italy
mariricci@deloitte.it

ILARIA DONÀ
Eminence and Market Insight Specialist
Clients & Industries
Deloitte Italy
idona@deloitte.it

MARCO TIRELLI
Eminence and Market Insight Specialist
Clients & Industries
Deloitte Italy
mtirelli@deloitte.it

With the active contribution of Talents Venture, a start-up of young professionals, specialized in analyzing the state of the Italian universities and the job market for college graduates. Talents Venture supports different stakeholders to understand the evolving world of Higher Education and seize its future development opportunities.

NOTE

Deloitte.

Deloitte Creative Team - Italy | SG.061.22