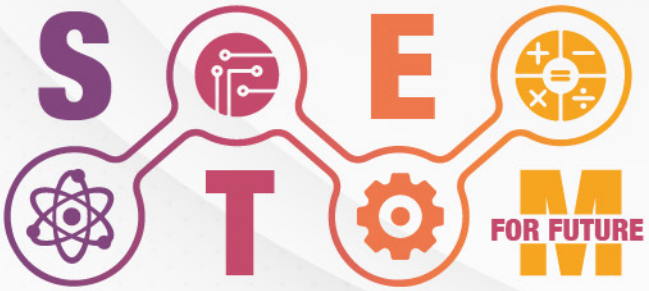

FOR FUTURE

PROJECT RESULT 3

GUIDELINES AND RECOMMENDATIONS FOR THE IMPLEMENTATION OF STEM POLICIES IN HIGH SCHOOLS

ifoa Sapere utile · UNIMORE · Saaremaa Gümnaasium · EDUGEP

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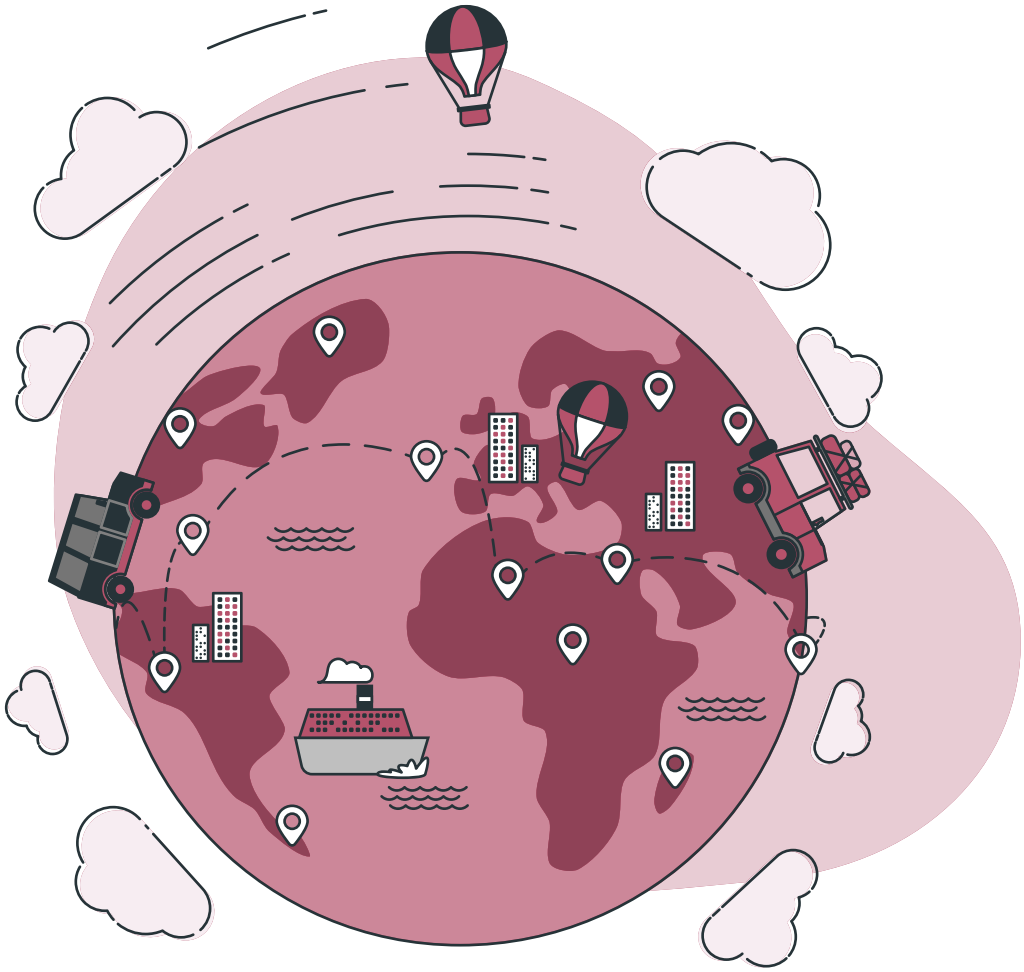

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Introduction

Objectives of the guidelines

These guidelines emerged as part of an interdisciplinary and partnership work in the implementation of the Erasmus+ Project called "STEM for Future", n. 2021-1-IT02-KA220-SCH-000034362 and were built through the collection of feedback of National Stem Camps and an International STEM Camp conducted by the following five partners:

- IFOA - Istituto Formazione Operatori Aziendali (IT)
- UNIMORE - Università degli Studi di Modena e Reggio Emilia (IT)
- Saaremaa Gümnaasium - upper secondary school (EE)
- EDUGEP - Concepção, desenvolvimento e Gestão de projectos de natureza educacional, social e cultural LDA (PT)
- CIPFP Misericordia - Centro Integrado Público de Formación Profesional Misericordia (ES)

With the purpose to help promote STEM education through the school system, these guidelines were thought in a way that incentives young students to gain technical, digital, and soft skills, to help them consider a career in a STEM area, to generate awareness for gender gaps or inequality issues as well as to contribute to creating equal and quality opportunities for young people's professional futures.

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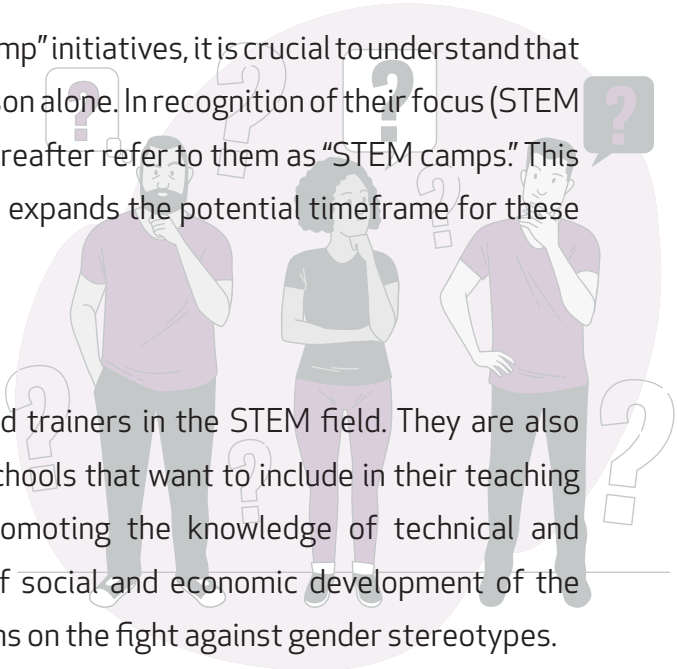
It's necessary to act in order to improve the percentage of Europeans with basic digital skills (nowadays only about 54% of Europeans have basic digital skills) as well as to diminish the big gender gap existent in this field, in which only one in five Information and Communication Technologies (ICT) specialists and ICT graduates are women . To better respond to current challenges, it should be awareness about these issues, and training opportunities for young students in a way that they could consider and benefit of job opportunities and careers in STEM areas, or other areas which require these types of digital skills.

These guidelines will provide information, tools, and feedback on previous experiences, in a way that it supports any entity in the education area or education element that wants to propose and test the implementation of STEM education and policies in high schools. These guidelines, together with the other results of the project, will form a toolkit with all the necessary resources to provide full support to those who want to implement STEM policies. To achieve that, these guidelines we will include:

- A section dedicated to methodological aspects and to the orientation of students toward their choice of study or career path.
- A section dedicated to the gender perspective, with the aim of providing tools and methods to help counteract stereotypes and stimulate female empowerment and self-esteem during STEM training itself (e.g., how to form teams in terms of gender composition).
- A collection of case studies related to partners' experiences during the implementation of national and international camps.

On a side note, while our project discusses "summer camp" initiatives, it is crucial to understand that these programs are not restricted to the summer season alone. In recognition of their focus (STEM disciplines) and their year-round revelance, we will hereafter refer to them as "STEM camps." This change better reflects their educational purpose and expands the potential timeframe for these enriching experiences.



To whom it is addressed and why

The guidelines are mainly addressed to teachers and trainers in the STEM field. They are also addressed to institutions, training bodies and high schools that want to include in their teaching activities aimed at stimulating STEM learning, promoting the knowledge of technical and professional paths consistent with the prospects of social and economic development of the territory and promoting training/awareness campaigns on the fight against gender stereotypes.

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The development of these guidelines paid particular attention to providing a wide variety of equivalent and alternative methods to support teachers in designing and delivering effective training sessions. There were considered the specific local and national context, in terms of educational background, employment prospects in the STEM field, mismatch between labour supply and demand and gender gaps in STEM disciplines at professional and university level.

Introduction to the reading

The guidelines are organized into six comprehensive chapters, complemented by two appendices, offering a thorough exploration of key dimensions. The chapters intricately delve into various aspects, including:

- A discerning analysis of essential skills, elucidating the pivotal competencies that underpin the subject matter.
- A comprehensive examination of the gender gap, shedding light on the challenges and opportunities in achieving equity within the discussed context.
- An in-depth exploration of the critical importance of guidance towards STEM subjects, emphasizing the broader implications and benefits.
- A detailed presentation of the recommended methodologies for these activities, providing practitioners with practical insights and strategic approaches.
- An exploration of the diverse tools available, coupled with an in-depth analysis of the outcomes resulting from these activities, offering a nuanced understanding of the impact.
- An examination of best practices within the specified domain, distilling insights and lessons learned from successful implementations.

These comprehensive guidelines represent the culmination of the collaborative efforts invested in "STEM for Future" project. The appendices accompanying these guidelines encompass Project Results 1, focusing on the structured format for implementing a STEM Camp, and Project Results 2, which thoroughly delineates the tools utilized for evaluation purposes. This holistic approach ensures that readers gain not only theoretical knowledge but also practical insights for effective implementation in their respective context. To better understand the guidelines, it is essential to know the collective expertise and diverse perspectives that contribute to the richness of this guide. The following sections present detailed profiles of the project partners, each of whom brings a unique blend of knowledge and experience to further enhance the depth and breadth of this valuable resource.

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- **IFOA - Istituto Formazione Operatori Aziendali (IT)**

IFOA develops projects with schools and training institutions, realising school, vocational and work orientation paths, PCTO - Cross-Competence and Orientation Programme, with innovative approaches attentive to the dynamics of change in the world of education and work. It is a training centre accredited by the Emilia-Romagna Region and the Chambers of Commerce and Industry and a Service and Counselling Centre for the Autonomous School Institutions of Emilia-Romagna accredited for A.S. 2022/2023. IFOA services are aimed at students, school managers, teachers, tutors, coordinators, guidance and training staff, families and operators.

Among the services IFOA offers to schools there are:

- Training and in-company experiences for students from all types of schools. Since 2016 IFOA has been registered in the National Register for Transversal Skills and Orientation of the Chambers of Commerce.
- Orientation, individual and group for the development of psychological, cognitive and relational characteristics necessary in the school/work context for professional choice.
- Training design: design and management of training courses on topics related to PON Scuola 2020.
- Digital Learning: IFOA offers - in collaboration with Cisco Systems - the opportunity for schools to participate in digital revolution skills assessment tests.
- Teacher training: training paths to update, innovate and support teaching
- Company and school tutor training for paths for the development of transversal skills and for orientation corresponding to school and company training plans.
- Internships and training abroad: in-company mobility in EU and non-EU countries.
- Health and safety at work: we train students and teachers in new ways of thinking and acting, using the language of theatre to represent risk events in the workplace.

- **UNIMORE - Università degli Studi di Modena e Reggio Emilia (IT)**

The University of Modena and Reggio Emilia (UNIMORE), founded in 1175, is among the oldest universities in the world and has always been ranked among the top Italian universities for quality of teaching and research. The University of Modena and Reggio Emilia (UNIMORE), founded in 1175, is among the oldest universities in the world and has always been ranked among the top Italian universities for quality of teaching and research. Leveraging its extensive experience in the scientific and technical/technological realm, UNIMORE recognizes the pressing need to engage

young people in STEM disciplines, especially during this digital transformation era. Mindful of the local socio-economic landscape, UNIMORE has been actively fostering the interest of youth in STEM fields to meet the evolving demands of the region. Complementing its Degree, Master's, and PhD programs, the university is committed to attracting an expanding cohort of students capable of addressing the area's economic and production needs while facilitating swift and fulfilling career placements.

In pursuit of this goal, UNIMORE conducts various orientation and preparatory activities, and since 2014 the annual "Ragazze Digitali" (Digital Girls) summer camp—a four-week initiative tailored for female high school students to kindle their interest in digital disciplines (www.ragazzedigitali.it).

Notably, starting from 2022, the camp is supported by the Emilia Romagna Region and has expanded its reach to all the main cities of the region, with the collaboration of four different universities. The initiative stands as a testament to UNIMORE's commitment to shape a skilled workforce that aligns with the dynamics of the digital age while providing valuable opportunities for the region's youth.

- **Saaremaa Gümnaasium (EE)**

The school's mission is to focus on student development: the school's educational approach, despite being open for only a few years, is based on the idea that learning is a life-long activity, in which the learning activities and the mental, physical and social learning activities and the mental, physical and social learning environment must be designed for the individual, to help students to achieve their intended learning goals.

Saaremaa Gymnasium has joined the global environmental education program Eco-Schools Global, which brings an environmentally friendly mindset to the school and helps members of the school community become sustainably thinking, environmentally-conscious individuals. We collaborate with the Estonian Association of Engineers within the programs of engineering talent development. We have initiated joint learning projects with TalTech Kuressaare College in blue- and green-economy technology. Students in our school's future technology field successfully participate in national cyber competitions. Teachers' activities are united by the educational design community, where a design-oriented way of thinking is applied to foster collaboration between teachers and students.
The focus on STEM disciplines is one of the cornerstones of school activities, also in view of the

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importance of technologies, especially IT, and their applications for the economy and employment in our country.

- **EDUGEP - Concepção, desenvolvimento e Gestão de projectos de natureza educacional, social e cultural LDA (PT)**

EDUGEP currently delivers training courses for adults in 17 areas including: teacher training, IT and advanced technologies. It provides pedagogical support services to young people in school contexts, from primary schools to university, covering all phases of intervention, from the initial diagnosis conducted by school psychologists to the design, delivery and evaluation of customised interventions according to the specific needs of individual students.

With regard to project-related activities, EDUGEP has been organising since 2016 ETECH PORTUGAL, a national technology fair that brings together the best of educational experiences in ICT and Electronics, also offering numerous conferences and workshops. It is also responsible for extra-curricular activities in 69 schools in the regions of Setúbal and Alentejo, with more than 6100 students involved. It is also a partner of the Portuguese Institute for Employment and Vocational Training, for the realization of training courses for unemployed young adults from the territory.

- **CIPFP Misericordia - Centro Integrado Público de Formación Profesional Misericordia (ES)**

CIPFP Misericordia is a Vocational Training state school, which combines extensive experience in teaching vocational training in the families of Administration and Management, Commerce and Marketing, Electricity and Electronics, and Sociocultural and Community Services (being a pioneer of these studies in the Valencian Community), with the latest educational and technological innovations CIPFP Misercordia has a long experience in EU projects, and is currently involved in different Erasmus+ KA2- projects (Strategic Partnerships) and in some mobility projects. Annually it carries out about 600 student and teacher mobilities. Between 2014 and 2016 the school participated in the UPPScience project (2016-1-NO01-KA202-022060), coordinated by the Polytechnic University of Trondheim (NO), aimed at promoting the use of STEM in vocational schools. The project was implemented on the basis of a previous KA2 project (VISCONTI) that established a community of practice on STEM, in which CIPFP Misericordia actively participates. CIPFP Misericordia also has experience in several EU projects on digital competences and soft skills, like DIGIT-GERA, another Erasmus+ project that is aimed to promote the social inclusion of senior citizens into digital society.

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1. Main goals of STEM for Future

1.1 Hard and soft skills

STEM stands for Science, Technology, Engineering, and Mathematics, which are essential areas for the advancement of today's digital world. Within these fields, there are numerous hard and soft skills that need to be developed. One of the main goals of the STEM for Future project is not only to raise awareness among young people of the potential of these four areas of knowledge but also to develop these same skills. Throughout the project, four national STEM Camps and one international were developed, aiming to provide young people with tools not only for practical knowledge of the four major areas but also to develop their soft skills.

While the project STEM for future allowed students to immerse themselves in the more technical and scientific aspects of this field, helping them to orient themselves for future choices, the activities implemented also supported students' growth in soft and transversal skills. These cannot be relegated to an innate ability, or to self-learning/non-formal learning, but should be understood and developed in welcoming and non-judgmental learning spaces, which allow for trying, failing, understanding, and trying again, in a process aimed at continuous improvement. It is important to understand that the development of social and emotional skills, not just hard skills, is highly valued in various professional contexts and should therefore be considered in the education and training of young people.

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Recognizing the need to transform STEM learning, aligning it with student expectations and the demands of modern society. To achieve this, the project incorporates a problem-based approach, emphasizing practical tasks that enable students to solve real-world issues, making learning more alive and relevant. In addition to enhancing technical skills, is recognized the importance of career education, facilitating cooperation with industry practitioners, company visits, and job-shadowing experiences. In essence, STEM education aligned with student expectations offers a holistic approach that not only equips them with technical knowledge but also empowers them with the essential soft skills for success in the modern world.

Therefore, during the STEM Camp activities, it was considered important to develop the following skills:

Soft Skills	
Task accomplishment	Problem solving
Empathy	Teamwork
Attention to detail	Discussion skills
Creativity	Leadership
Organization	Respect
Assertive Communication	Decision making
Analytical thinking	Time management

Hard Skills
Programming / Coding Technology
Hardware Knowledge Technology
Design and Modeling Technology / Mathematic
Robotics, Soldering, 3D Printing Technology / Mathematic / Engineering
Eletronic circuits Engineering
Physics, Chemistry and Biology Science
Scientic Experiment Execution Science

1.2 Knowledge of the STEM areas

1.2.1 Importance, applicability, and usefulness for student employability

The need for adaptation of employees and companies is accelerated by the introduction of new technologies in the workplace, such as automation and artificial intelligence, which came along with the Industrial Revolution. In today's world, STEM knowledge has become increasingly important. This adaptation requires an increased acquisition of new sets of technological, social,

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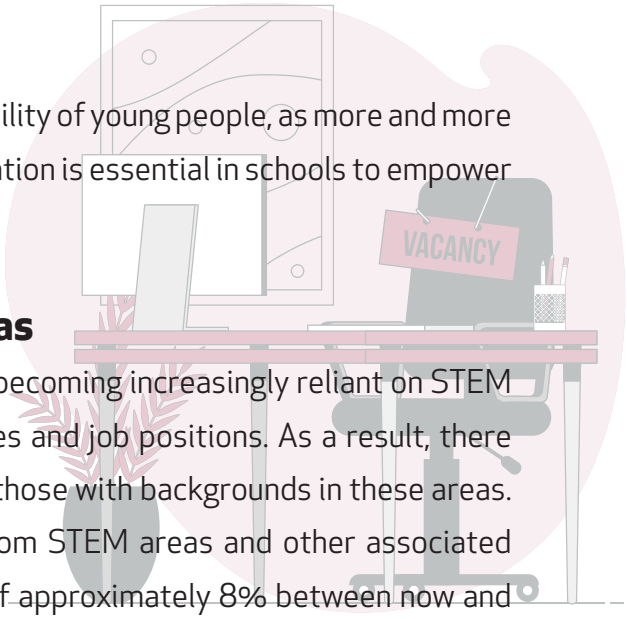
and emotional skills, leading to significant changes for both employees and companies who need to quickly adapt to these evolving changes. According to Education at a Glance 2022, a study by the Organization for Economic Co-operation and Development – OECD, obtaining a university degree is still the best way to secure a good-quality job, and STEM fields are the most prevalent in OECD countries. Therefore, to ensure competitiveness in the job market, it is necessary to provide students with a solid STEM education in schools to capacitate them to work in any area and with fundamental skills for the increasingly digital world we live in, including logical and critical thinking skills, mathematical approach in real-life situations, knowledge of scientific principles, and practical solutions for real-life situations.

In summary, STEM knowledge is essential for the employability of young people, as more and more jobs require scientific and technological skills. STEM education is essential in schools to empower students to work in any field and for the future economy.



1.3 Employment perspectives of STEM areas

As we move further into the digital age, the job market is becoming increasingly reliant on STEM skills as they are considered essential across all industries and job positions. As a result, there are more employment opportunities than ever before for those with backgrounds in these areas. According to CEDEFOP, the demand for professionals from STEM areas and other associated professionals with STEM Skills has an expected growth of approximately 8% between now and 2025, which is much higher than the average 3% growth prediction for all occupations. Additionally, employment in STEM-related sectors also has an expected growth of around 6.5% between now and 2025.

Workers who possess these skills are more likely to be hired, promoted, and earn higher salaries. Moreover, these skills provide a competitive advantage for workers who are seeking to advance their careers and stay relevant in the job market.

However, it's important to note that the demand for STEM skills is not limited to traditional STEM fields. Many industries, including healthcare, finance, and marketing, are increasingly relying on technology and data analysis, creating a need for workers with STEM backgrounds. In sumary, individuals with STEM skills have a wide range of employment opportunities available to them, as the world becomes increasingly reliant on technology and innovation, there is a growing need for

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workers with expertise in STEM areas. The potential for high salaries, career advancement, and a wide range of job opportunities make STEM-related careers an attractive choice for many.

1.4 Gender gap

Even today, there is a significant gender disparity in the fields of STEM. In education, there are fewer girls enrolled in STEM programs than boys, and this trend continues in career choices later. While the link between educational attainment and employment rates holds for men and for women, it is particularly strong for women. Despite women representing about half of the workforce, they are underrepresented in many STEM professions, including engineering, physics, and computer science.

One of the enduring reasons for this disparity lies in the deeply rooted societal perception that women have historically been deemed less naturally suited for STEM careers compared to men. This cultural theme, persisting over time, has contributed to the underrepresentation of women in STEM fields. This can be reinforced from childhood, when girls are less encouraged to play with science toys or to take an interest in science and technology.

In addition, there are gender biases in the workplace and stereotypes that can discourage women from pursuing careers in STEM. Even today, women are perceived as more suitable for staying at home to take care of the family instead of pursuing a career, and therefore there is less incentive for their education. They are indeed discouraged from pursuing higher education and achieving high positions (Makarem and Wang, 2019).

This gender disparity has a significant impact on the economy and society. On the one hand, companies that fail to recruit women for STEM areas lose valuable talent, and on the other hand, women lose out on lucrative and challenging career opportunities. In addition, the lack of gender diversity in STEM can limit creativity and innovation and perpetuate harmful stereotypes.

To overcome this disparity, a joint effort from governments, companies, and society is necessary. This includes actions such as encouraging girls to take an interest in science and technology from an early age, creating diversity policies and programs in companies and universities, and promoting successful female role models in STEM. Gender diversity in STEM is not only a matter of social justice but also a key element for a stronger economy and a more equitable and inclusive society.

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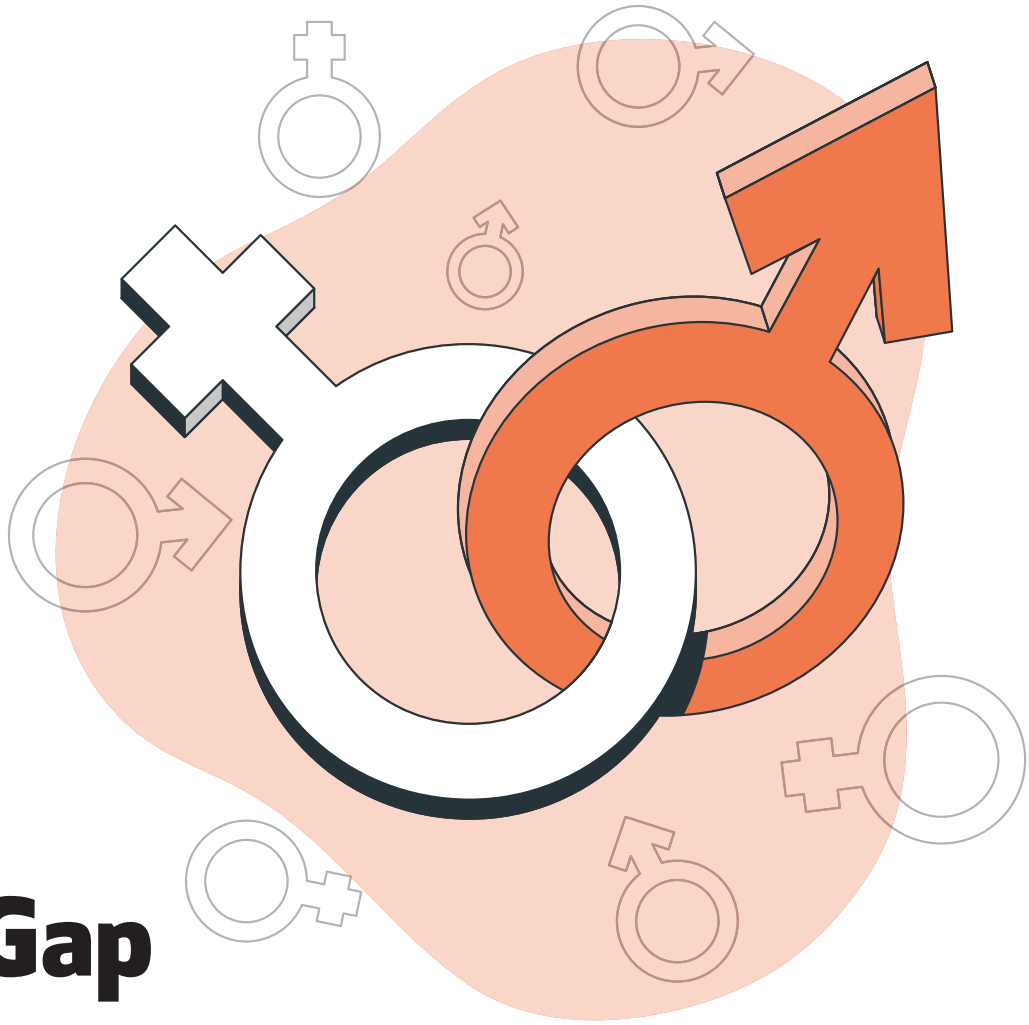

2. Gender Gap

2.1 Is there a gender gap?

Considering the gender gap in STEM is of utmost importance for achieving greater gender equality and fostering innovation and economic growth. In a recent article from Eurostat (March, 2023),, it was reported that in 2021 approximately 6.6 million women were employed as scientists and engineers in the European Union, representing a 41% share of total employment in these fields. However, significant disparities persist across sectors. Women remain underrepresented in manufacturing, where only 21% of scientists and engineers are female, while a more balanced gender distribution is observed in the services sector with 46% representation. The proportion of female scientists and engineers varies among EU Member States, ranging from the highest shares in Lithuania (52%) and Bulgaria, Latvia and Portugal (all 51%) to the lowest in Luxembourg (35%), Germany and Italy (both 34%), Hungary (33%) and Finland (31%). These statistics emphasize the need for targeted efforts to address gender imbalances and create inclusive environments that empower women to pursue and thrive in STEM careers. Recognizing the potential of diverse

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perspectives and talents, it is essential to promote educational opportunities, eliminate biases and stereotypes, provide mentorship, and support networks, and foster inclusive workplace cultures. By ensuring equal representation and participation of women in STEM, societies can benefit from a broader talent pool, innovation, and improved competitiveness in the global arena.

2.2 Does it affect all fields of STEM areas?

The gender gap in STEM fields is not evenly distributed and manifests with varying intensity across different disciplines. The Digital Economy and Society Index (DESI) 2022, along with data from the United States, corroborates this observation, highlighting that the issue is more pronounced in engineering and ICT fields compared to biological and chemical sciences. The DESI 2022 index indicates that women are particularly underrepresented in ICT and engineering sectors; for example, only 19% of ICT specialists in the EU are female. Conversely, the gender ratio in the services sector shows a relatively more balanced distribution, with 54% male and 46% female representation.

2.3 Are there still prejudices associated to genders?

Prejudice in STEM fields is a well-documented issue that has garnered attention from researchers and scholars. Numerous indexed scientific articles have shed light on the presence and impact of prejudice on individuals pursuing careers in science, technology, engineering, and mathematics. For instance, a study by Moss-Racusin et al. (2012) titled "Science Faculty's Subtle Gender Biases Favor Male Students" investigated the existence of bias in faculty evaluations of undergraduate students in STEM disciplines.

The research revealed that both male and female faculty members exhibited bias, rating male students more competent and deserving of higher career mentoring and salary recommendations compared to equally qualified female students. This study highlights the insidious nature of bias, even among professionals within the STEM community. In contrast, many works demonstrate how there are no differences in terms of performance in areas such as mathematics, science, and engineering. In a very broad example, a notable study by Milkman et al. (2014) titled "Evidence for a Collective Intelligence Factor in the Performance of Human Groups" explored the theme of collective intelligence. The research found that a general collective intelligence factor explains a group of people's performance on a variety of tasks. Researchers were able also to demonstrate the correlation between such intelligence and, among others, the proportion of females in the group.

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2.4 How to counter stereotypes?

Recognizing the impact of stereotypes in STEM fields is essential for fostering diversity, inclusion, and equal opportunities. Extensive research has highlighted the negative effects of stereotypes on individuals' aspirations, self-perception, and career decisions within STEM.

It is important to adopt effective strategies. One such strategy involves the provision of positive role models and the promotion of diverse representations in STEM settings. Studies have consistently shown that exposure to successful role models from underrepresented groups can challenge stereotypes and inspire individuals to pursue STEM careers. Furthermore, creating inclusive educational environments that value diversity and address biases plays a significant role in reducing stereotype threat and fostering a sense of belonging for underrepresented individuals in STEM. Encouraging collaborative learning, implementing mentorship programs, and adopting inclusive teaching practices that ensure equal participation and active engagement also contribute to combating stereotypes and cultivating inclusive STEM environments.

2.5 How to reduce the gap?

The gender gap in STEM fields, where women are traditionally underrepresented, remains a significant concern. Addressing this disparity is crucial for achieving equality and harnessing the full potential of diverse talent in STEM-related industries. To bridge this gap, it is essential to adopt evidence-based strategies and initiatives that empower girls and women to pursue and thrive in STEM careers.

- **Inclusive Education:** One effective way to reduce the gender gap in STEM fields is by incorporating female references in school textbooks, curricula, and educational materials. By highlighting the contributions of female scientists, engineers, and mathematicians, educational institutions can provide girls with relatable role models and inspire interest in STEM subjects from an early age. Additionally, the development of non-competitive STEM activities and training programs for young children can help create a welcoming and less intimidating environment, encouraging their participation in STEM.

- **Female Role Models:** Providing students with female role models in STEM is crucial. Exposure to female teachers, professionals, and experts in STEM fields can be achieved through training seminars, visits to companies, and mentoring programs. These interactions offer invaluable insights into potential career paths and help young women

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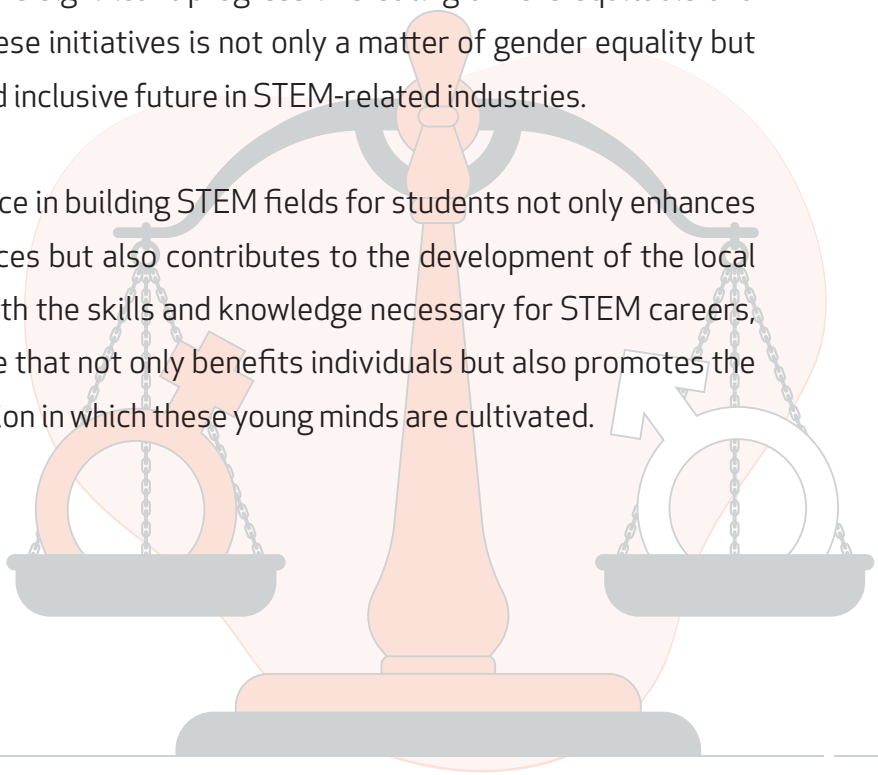
envision themselves succeeding in STEM.

- **Initiatives that have proven effective:** Initiatives like 'Girls First' within programs such as FIRST® LEGO® League that introduce STEM concepts to children aged 4-16 through hands-on, engaging activities. By promoting gender diversity within these initiatives and supporting female teams, young girls receive encouragement and support to explore STEM interests, fostering their confidence and skills.

- **Research and Awareness:** To address stereotypes and practices limiting access to STEM-related education for women and girls, research plays a critical role. The 'How to Address Stereotypes and Practices Limiting Access to STEM-Related Education for Women and Girls' report by a UOC researcher offers valuable insights. Key aspects emphasized in the report include focusing on students' skills and abilities rather than gender, promoting STEM education as an advantage in the family and society, and training teachers on equality while using non-sexist teaching materials featuring female role models.

Reducing the gender gap in STEM fields is a multifaceted effort that requires the collaboration of educators, policymakers, organizations, and society. By incorporating female references in education, providing female role models, fostering inclusive STEM activities, and drawing from research-backed strategies, we can make significant progress in creating a more equitable and diverse STEM workforce. Embracing these initiatives is not only a matter of gender equality but also a path toward a more innovative and inclusive future in STEM-related industries.

Furthermore, fostering effective guidance in building STEM fields for students not only enhances their educational and professional choices but also contributes to the development of the local community. By empowering students with the skills and knowledge necessary for STEM careers, we are laying the foundation for a future that not only benefits individuals but also promotes the overall growth and prosperity of the region in which these young minds are cultivated.



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3. How to guide people into STEM

3.1 The importance of guidance for young people

In our increasingly intricate society, navigating the complexities of career development for young individuals stands as a formidable challenge. The key lies in providing them with guidance that transcends mere information and fosters intelligent, motivated decisions about their educational journey. It's about preventing premature disengagement from education and training and shaping a future that aligns with their aspirations and societal needs. In this regard, STEM emerges as a vital arena, brimming with opportunities that can propel our collective progress. However, the path to realizing these potentials is rife with hurdles.

The essence of effective guidance goes beyond transactional advice; it should encompass a profound, existential aspect, an intimate connection with the educational experiences throughout one's curricular journey. This guidance hinges on the notion of 'personal appropriation,' recognizing that culture is not an abstract concept but a collection of life-enriching 'goods.'

Achieving clarity in educational decisions, which ultimately delineates one's 'place in the world,' hinges on three critical conditions:

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- Firstly, it relies on the quality of the educational canon and the experiences provided both inside and outside the classroom. The nature of these experiences significantly shapes a young person's trajectory.
- Secondly, the opportunity to test these educational experiences is crucial, allowing individuals to discern their real-world relevance and personal benefit. Education should not be confined to theory but should resonate with practicality.
- Thirdly, a suitable spatial-temporal and relational context is necessary for reflection and dialogue with significant figures like parents, teachers, mentors, and peers. These interactions help translate one's educational journey into self-awareness and the realization of their capacity for positive impact in our complex world.

This conception of guidance is in alignment with the UNESCO document outlining the goals of education for 2030. These goals, seen as indispensable tools for sustainable development, call for a profound transformation in educational processes. They emphasize the development of competencies that enable individuals to reflect on their actions, considering their broader social, cultural, and economic implications.

It's imperative that education becomes not only of high quality but also lifelong. Furthermore, educational systems should adopt a transformative pedagogy, forcing a reevaluation of content and outcomes to ensure that young minds are equipped to thrive in an ever-evolving world.

This underscores the need for a robust renewal of guidance models along three pivotal dimensions:

- Transitioning from isolated, last-minute interventions to a unified, long-term strategy that guides individuals throughout their educational journey.
- Evolving beyond the mere dissemination of information towards a formative and vocational approach, which instills practical knowledge and understanding of the challenges and opportunities within chosen paths.
- Integration of all involved actors and the array of guidance resources into a coherent, custom-tailored approach that empowers individuals to take responsibility for their choices and chart their own course.

This approach calls for experiential activities that put students at the forefront of their guidance process, cultivating a 'guidance mentality' among all stakeholders. It aims to enhance transversal skills and imbue career-seeking processes with a sense of meaning and fulfillment.

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In essence, guidance pathways should evolve into lifelong, transversal, and workshop-like experiences, underpinned by a strong educational alliance that ensures guidance is both 'early' and preventive. This proactive stance is critical in addressing cognitive biases and societal prejudices, which have persisted despite more than a century of guidance practices.

In parallel, the labour market beckons young talents, demanding a seamless transition from education to employment. Immersing young people in activities that mirror real-world work experiences can instill positive career aspirations, attitudes, behaviors, and essential workplace skills.

In summary, the journey towards equipping young individuals with the guidance they need to make informed career decisions and lead fulfilling lives extends beyond conventional advice. It encompasses a profound connection with their educational experiences, a focus on societal well-being, and a commitment to lifelong learning. By nurturing this holistic approach, we ensure that every young person, irrespective of their background or gender, can navigate the complexities of our ever-evolving world with confidence and purpose.

Moreover, guidance into the realm of STEM serves as a potent antidote to the stereotypes and biases that frequently deter young individuals, especially girls and underrepresented minorities, from pursuing STEM careers. By granting access to female and minority role models and illuminating the diverse spectrum of careers within STEM, guidance initiatives have the potential to cultivate a more inclusive and heterogeneous workforce, enriched by a tapestry of perspectives and talents. Additionally, steering young individuals toward STEM can help counteract the impending shortage of skilled workers in these fields, which is exacerbated by an aging workforce and an escalating demand for STEM-related positions. Thus, motivating more young talents to embark on STEM careers becomes imperative to ensure a sustainable future.

By affording young minds exposure to STEM subjects and careers and nurturing a workforce that is more inclusive and diverse, we lay the foundation for everyone to contribute to the innovative and groundbreaking work unfolding in STEM. However, addressing the STEM gender gap remains a significant challenge, perpetuated by societal constraints that dissuade many female students from pursuing STEM fields. From their early years, some girls perceive STEM as unrelated to their interests or abilities. A core issue contributing to this gender disparity is the lack of female references in these disciplines.

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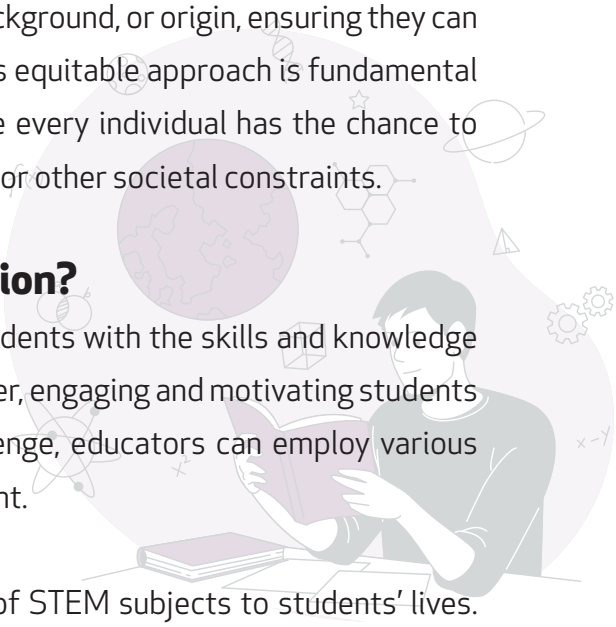
Guidance, therefore, assumes a crucial role in dismantling these social prejudices and fostering gender equality in STEM. The overarching goal of guidance should align with the 2030 Agenda and the Sustainable Development Goals (SDGs), particularly SDGs 5, 8, and 10. It aims to provide equal opportunities for all students, regardless of gender, social background, or origin, ensuring they can develop successful and meaningful professional careers. This equitable approach is fundamental to achieving a more inclusive and sustainable society where every individual has the chance to contribute their talents and expertise, irrespective of gender or other societal constraints.

3.2 How to engage students at STEM education?



STEM education is a pillar of modern learning, equipping students with the skills and knowledge needed to thrive in our increasingly tech-driven world. However, engaging and motivating students in STEM subjects can be a challenge. To address this challenge, educators can employ various strategies to make STEM education more exciting and relevant.

Firstly, it's crucial to demonstrate the real-world relevance of STEM subjects to students' lives. When students can connect what they're learning to current events or issues that matter to them, such as climate change, healthcare, or technological innovations, their interest and engagement naturally increase. Educators should strive to bridge the gap between abstract concepts and tangible, practical applications, making STEM subjects feel more pertinent and immediate.

Hands-on activities and experiments also play a pivotal role in stimulating students' curiosity and interest in STEM. By providing opportunities for students to see and experience the practical applications of STEM concepts, educators enable them to not only grasp the knowledge but also develop a deeper understanding. Project-based learning is an effective approach that encourages students to explore and discover STEM topics independently, fostering a sense of ownership and curiosity.

Furthermore, technology can be a powerful ally in engaging students in STEM education. Many students today are digital natives, comfortable with technology as part of their daily lives. Integrating technology into the classroom can create interactive and immersive learning experiences. Virtual reality simulations, for example, can transport students to different environments, making abstract concepts tangible and engaging. Incorporating games and competitions into STEM education adds an element of excitement and motivation. Activities like coding challenges, robotics competitions,

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or science fairs not only make learning fun but also inspire students to pursue STEM education further. They provide opportunities for students to apply their knowledge and skills in practical, real-world scenarios, reinforcing the value of STEM education.

Creating a positive and inclusive learning environment is equally essential. Educators should actively promote diversity and equity in STEM education, ensuring that all students, regardless of their background or gender, feel valued and respected in the classroom. Inclusive classrooms foster a sense of belonging, encouraging students to fully participate and excel in STEM subjects.

It is crucial to devise methods to engage and activate young people. For instance, within the framework of the STEM for Future project, the role of STEM Ambassadors has been established: young students who have participated in National and International camps (3 per country), and who have become advocates for the experiences and their respective impacts. They have contributed to the design of the international camp by providing precise feedback on the activities conducted during the national camps. Furthermore, they have been actively involved in shaping the project's communication strategy.

Drawing on valuable insights shared by the Ambassadors, who represent our project's primary audience and the future workforce, here are some essential considerations to engage students at STEM areas:

- **Striking a Balance Between Theory and Enjoyment:** As per the Ambassadors' feedback, achieving equilibrium between traditional theoretical learning and enjoyable, user-friendly activities is crucial. Students flourish when exposed to a mix of challenging subject matter and captivating, enjoyable learning experiences.
- **Embracing the Power of Challenge-Based Learning:** Challenge-Based Learning (CBL) emerges as an effective motivator for students. The prospect of creating and presenting a final product or addressing real-world issues as part of their training keeps them invested and enthusiastic about their educational journey.
- **Placing Emphasis on Technology:** Among the various STEM disciplines, Technology, especially involving robotics and programming, holds a special appeal for students. Tailoring educational experiences to align with these preferences can significantly boost their motivation.
- **Championing Collaborative Efforts:** Collaboration isn't merely a preference but a

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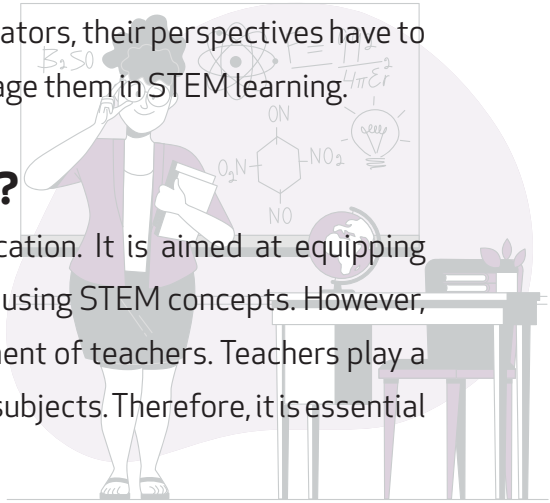
fundamental requirement for students. Pre-established groups with roles that rotate encourage teamwork, allowing students to learn from each other and develop valuable interpersonal skills.

- **Encouraging Real-World Problem Solving:** Students strongly favor STEM education that revolves around practical problem-solving scenarios. This approach helps them recognize the tangible advantages of STEM in addressing real challenges in the world around them.
- **Highlighting the Impactful Applications of STEM:** Demonstrating how STEM fields directly shape the future and impact everyday life resonates with students. Activities that illustrate the concrete influence of STEM on society and personal experiences can instill a deeper sense of purpose and motivation.

These insights, directly sourced from the voices of students actively participating in the project, underscore the critical importance of customizing STEM education to align with their unique needs and aspirations. As the upcoming generation of workers and innovators, their perspectives have to guide the strategies and approaches we adopt to inspire and engage them in STEM learning.



3.3 How to involve teachers at STEM education?

STEM education has become a critical aspect of modern education. It is aimed at equipping students with the necessary skills to tackle real-world problems using STEM concepts. However, the success of STEM education is heavily reliant on the involvement of teachers. Teachers play a significant role in guiding and motivating students towards STEM subjects. Therefore, it is essential to find ways to involve and motivate teachers in STEM education.

One of the most effective ways to involve teachers in STEM education is through professional development programs. These programs should be tailored to equip teachers with the necessary skills and knowledge to teach STEM subjects effectively. Such programs should include training on the latest teaching methods, use of technology, and practical application of STEM concepts. Professional development programs should also provide opportunities for teachers to network with other educators and STEM professionals.

Another way to involve teachers in STEM education is through mentorship programs. These programs pair experienced STEM educators with less experienced ones, allowing for the sharing of knowledge and skills. Mentorship programs provide opportunities for teachers to learn from each other, collaborate on STEM projects, and provide support and guidance.

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Additionally, involving teachers in the development of STEM curriculum can increase their interest and involvement in STEM education. Teachers are more likely to be invested in STEM subjects if they contribute to the design of the curriculum. By involving teachers in the curriculum development process, they can provide insights into what works best for students, the challenges they face, and the resources they need to teach STEM subjects effectively.

Collaboration between schools and STEM professionals can also help involve teachers in STEM education. Teachers can benefit from partnerships with STEM professionals who can provide access to resources, expertise, and real-world applications of STEM concepts. This collaboration can involve industry visits, guest lectures, and joint research projects.

Finally, it is essential to provide teachers with access to resources and support for teaching STEM subjects. This can include access to STEM kits, software, and other tools that can enhance the learning experience. Providing teachers with a support system, such as a STEM coordinator or department head, can also help them feel supported and empowered to teach STEM subjects effectively.

Ultimately, involving teachers in STEM education is vital for the success of STEM education. Teachers play a significant role in motivating and guiding students toward STEM subjects. Therefore, it is important to provide teachers with professional development programs, mentorship opportunities, involvement in curriculum development, collaborations with STEM professionals, and access to resources and support for teaching STEM subjects. By doing so, we can create a more effective and engaging STEM education system.

3.4 How to include STEM subjects into school's curriculum?

Integrating STEM (Science, Technology, Engineering, and Mathematics) subjects into the school curriculum is not just about imparting knowledge; it's about equipping students with essential skills for success in their future endeavors. Several key considerations can guide us in effectively involving STEM subjects in the curriculum.

- **Nurturing Crucial Skills:** Students require a diverse set of skills to thrive in their lives, including teamwork, creativity, critical thinking, problem-solving, and communication. One effective approach is to infuse STEM activities into Arts and Humanities curricula. This integration not only enhances mathematical learning but also improves students'

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speaking and writing abilities, fostering a well-rounded skill set.

- **Fostering Real-Life Relevance:** Engaging students in STEM subjects hinges on making classes interesting and relevant to their lives. When students perceive the practical applicability and real-world relevance of STEM concepts, they are more likely to remain engaged and enthusiastic about their studies. This practicality and flexibility should be woven into school education, with teachers playing a pivotal role in shaping students' perceptions of STEM subjects.
- **Holistic Development:** STEM encompasses various skills, including research skills, algorithmic thinking skills, mathematical problem-solving skills, and IT skills. While research skills receive considerable attention and are emphasized in national curricula, other STEM skills related to computer education, such as algorithmic thinking and IT skills, should not be overlooked.
- **Early Engagement:** To ignite interest in the STEM field, it's crucial to engage students from an early age. The transition to secondary education often marks a point where students face increased study loads, potentially limiting their involvement in other activities. Moreover, peer influence plays a significant role, as friends quitting shared activities can deter students. Thus, early childhood and primary school education play a pivotal role in sparking and sustaining interest in STEM.
- **Interdisciplinary Connections:** Breaking down the traditional boundaries between subjects and scientific fields is vital. In an open and information-rich learning environment, educators should consciously create connections between subjects, fostering a holistic understanding of STEM concepts.
- **Student-Centric Insights:** Understanding STEM from students' perspectives is invaluable. Key takeaways include recognizing that curiosity drives learning, technology education extends beyond coding, mastering the art of learning is a primary challenge, peer learning is as impactful as mentorship, industry professionals share the responsibility of educating future generations, and girls need additional encouragement and support to explore the technology and programming fields.

In conclusion, including STEM subjects in the school curriculum requires a multifaceted approach. By infusing real-life relevance, holistic skill development, early engagement, interdisciplinary connections, and a student-centric mindset, educators can create a curriculum that not only imparts knowledge but also cultivates the essential skills and passion necessary for students' future success.

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3.5 How to stimulate empowerment in young students?

Empowerment starts with education. Young people need to be enlightened about the world around them, including the opportunities and challenges they may face. They need to be taught how to make informed decisions, how to identify and achieve their goals, and how to be resilient in the face of adversity. Education is the key to unlocking the potential of young people and empowering them to take control of their lives.

Empowerment is the process of enabling individuals to take control of their lives, make their own decisions, and take action towards achieving their goals. Empowering young students can have a significant impact on their academic and personal growth, as it can lead to increased confidence, motivation, and self-esteem. Here are some ways to stimulate empowerment in young students:

- **Provide opportunities for choice and decision-making:** Allowing young students to make choices and decisions about their learning can give them a sense of control and ownership over their education. Teachers can provide options for assignments, projects, or activities, and encourage students to choose what they are interested in or what suits their learning style.
- **Encourage self-reflection and goal setting:** Teachers can facilitate opportunities for students to reflect on their learning and set goals for themselves. This can help them identify their strengths and areas for improvement, as well as give them a sense of direction and purpose in their studies.
- **Foster a growth mindset:** Encouraging students to embrace a growth mindset can help them see challenges as opportunities for growth and learning. Teachers can praise effort and persistence over innate ability and provide feedback that focuses on improvement rather than just performance.
- **Create a supportive learning environment:** A positive and supportive classroom environment can promote empowerment in young students. Teachers can establish clear expectations, provide constructive feedback, and create opportunities for collaboration and teamwork.
- **Provide opportunities for leadership and responsibility:** Teachers can empower students by giving them opportunities to take on leadership roles and responsibilities in the classroom or school community. This can help them develop important skills such as communication, problem-solving, and decision-making.
- **Trial and Error approach:** Giving room for error and resistance to frustration is a

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fundamental approach to encouraging students to continue their studies and seek promising careers in any field, but especially in STEM areas, which are seen as challenging paths. By involving students in activities that promote trial and error, we are strengthening their resilience and reducing their fear of failure. When young people understand that making mistakes is a normal and valuable part of the learning process, they develop a healthier self-image and greater self-esteem. This encourages them to face challenges, embrace new ideas and persist in their educational and professional journeys in STEM, knowing that every mistake is an opportunity for growth and improvement.

- **Celebrate successes:** Recognizing and celebrating students' achievements can boost their confidence and sense of empowerment. Teachers can acknowledge and celebrate academic accomplishments, as well as other accomplishments such as personal growth and community service.

All things considered, stimulating empowerment in young students is essential for their academic and personal growth. Teachers can provide opportunities for choice and decision-making, encourage self-reflection and goal setting, foster a growth mindset, create a supportive learning environment, provide opportunities for leadership and responsibility, and celebrate successes. By providing them with education, mentorship, resources, and opportunities to make a positive impact, we can help young people develop the skills, confidence, and sense of purpose they need to thrive in life. Empowerment is not just about giving young people the tools they need to succeed, but also about creating an environment where they feel supported, valued, and respected as individuals.

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4. Recommended methodology

Selecting the right methodology is paramount in creating a vibrant and enriching STEM camp experience. This chapter delves into the significance of methodological choices, exploring how they shape the overall structure and effectiveness of the program. As we navigate through various approaches, the aim is to establish a solid foundation that ensures each moment at the camp contributes meaningfully to the participants' growth and enjoyment

4.1 Challenge Based Learning Methodology

Challenge-Based Learning (CBL) stands as an educational approach deeply rooted in practical experiences. It places participants in the midst of real-world issues, encouraging them to grapple with problems relevant to their own surroundings. Through this process, they explore various avenues for improvement and ultimately devise solutions to these challenges, which are subsequently put into action and assessed.

CBL offers an effective framework for learning that simultaneously addresses tangible, real-life problems. Within this framework, collaboration thrives as individuals work together to identify significant concepts, pose meaningful questions, and methodically dissect and resolve issues. By embracing CBL, learners not only acquire a profound understanding of the subject matter but also cultivate the skills necessary to adapt to an ever-evolving world.

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Students, whether working in teams or individually, can create an array of products. The breadth and depth of these creations may vary, contingent upon factors such as the stage at which students enter the process, their educational backgrounds, and their grade levels.

At the outset of a challenge, it is essential for both teachers and students to collaborate in delineating the desired products and devising a comprehensive assessment strategy.

The CBL structure encompasses seven key components:

- **The challenge proposal:** This sets the stage by presenting the overarching issue to be addressed.
- **Guiding questions:** These serve as beacons, illuminating the path toward understanding and solving the challenge.
- **Research plan and timeline:** A structured plan and timeline are crucial for guiding the research phase, ensuring that it progresses smoothly and systematically.
- **Implementation and evaluation plans:** These delineate how the proposed solution will be put into practice and subsequently evaluated for its effectiveness.
- **Solution:** The culmination of the CBL journey, the solution represents the practical outcome, providing a tangible answer to the initial challenge.
- **Student journals, written or video:** These journals capture the students' reflections, insights, and observations throughout the CBL process, offering a valuable record of their growth and learning.
- **Final reflection:** The concluding step involves reflecting on the entire CBL experience, highlighting key takeaways and areas for further improvement.

4.2 Teamwork Based Learning Methodology

As outlined by DeChurch and Mesmer-Magnus (2010), the Teamwork methodology is a structured approach employed by teams to achieve their goals and objectives effectively. It encompasses a range of practices and processes that facilitate communication, decision-making, coordination, and problem-solving within a team context.

To implement this methodology successfully, several key stages should be defined:

- **Definition of Prior Knowledge:** Before students engage in any activity, it is imperative to identify the prerequisite knowledge and skills necessary for their participation.

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Additionally, teachers should establish how this essential knowledge will be imparted to the students effectively.

- **Formation of Team Groups:** The constitution of teams is a critical step in Teamwork Based Learning Methodology. Teachers have to create balanced and diverse teams to foster collaboration and the exchange of ideas.
- **Inter-team Communication:** Effective communication between teams is paramount to the success of this methodology. Establishing channels for inter-team communication ensures that information, insights, and progress are shared efficiently.
- **Role Definition for the Tutor:** Tutors serve as facilitators, guiding and supporting the teams throughout the learning process. Their responsibilities may include providing guidance, addressing questions, and ensuring that the teams remain on track.
- **Evaluation and Peer Assessment:** The methodology incorporates a peer assessment mechanism as part of the evaluation process. Team members evaluate each other's contributions, fostering accountability within the teams and promoting fairness in assessing individual performance. This peer assessment not only provides valuable feedback but also encourages self-awareness and personal growth.

4.3 Project Based Learning Methodology

Project-Based Learning Methodology (PBL) is an educational approach that emphasizes active and hands-on learning through the completion of projects. In this method, students engage in meaningful and interdisciplinary activities that require real-world research, collaboration, and problem-solving. PBL offers an effective way to involve students in their education while promoting the development of essential cognitive and social skills.

The application of Project-Based Learning Methodology involves several key steps:

- **Selection of a Topic or Theme:** The first step is to choose a relevant topic or theme that is appropriate for the students and aligned with learning objectives. This can be done by the teacher or in collaboration with the students.
- **Formulation of Guiding Questions:** After selecting the topic, guiding questions are formulated to stimulate students' curiosity and guide their inquiry. These questions serve as the foundation for the project.
- **Research and Exploration:** Students are encouraged to conduct independent research to gather relevant information about the topic. They can use various resources such as

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books, articles, interviews, and digital technology.

- **Team Collaboration:** PBL often involves teamwork, where students collaborate to share knowledge, ideas, and resources. This promotes communication and cooperation skills.
- **Project Design:** Based on their research and findings, students design a specific project to address the guiding questions. The project can take various forms, such as presentations, reports, product creation, demonstrations, or practical actions.
- **Project Implementation:** Students carry out the project, applying what they have learned during research and collaboration. This involves problem-solving and overcoming practical challenges.
- **Presentation and Evaluation:** Upon completing the project, students present their findings and results to the class or a broader audience. Evaluation can be done by peers, the teacher, or external experts.
- **Reflection and Learning:** After the presentation, students reflect on the learning process and the lessons they have gained. This promotes metacognition and the development of self-reflection skills.

Project-Based Learning Methodology is highly flexible and can be applied in a variety of subjects and grade levels. It offers opportunities for students to explore their interests, deepen their understanding of relevant topics, and develop critical skills such as critical thinking, problem-solving, communication, and collaboration.

Furthermore, PBL can be adapted to meet the specific needs of students and learning objectives. It fosters an active and engaging learning environment where students are encouraged to become independent and creative thinkers, preparing them for real-world challenges.

4.4 Choice of activities

4.4.1 Transversal factors to consider

When selecting activities several crucial factors should be taken into consideration. These factors not only ensure the effectiveness of the activities but also contribute to the overall goal of emphasizing the applicability and usefulness of STEM disciplines in everyday life. Below are the key factors that should guide the choice of STEM-related activities:

- **Diversity:** Participants, especially students, are continuously seeking new challenges and incentives to maintain their motivation. Therefore, it's essential to offer a diverse range of

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activities that provide fresh and engaging experiences. Diversity keeps students engaged and excited about exploring STEM subjects.

- **Applicability in Real Life:** One of the primary objectives of these activities is to help students realize the practicality and relevance of STEM disciplines in their daily lives. Activities should be chosen to clearly demonstrate how STEM knowledge and skills are applied in solving real-world problems.
- **Sustainability and Alignment with SDGs:** STEM activities should align with the United Nations' Agenda 2030 Sustainable Development Goals (SDGs). Choosing activities that promote sustainability and contribute to addressing global challenges can enhance students' awareness of the broader impact of STEM.
- **Fun and Playful Character:** To maintain students' interest and enthusiasm, STEM activities should incorporate elements of fun and play. Implementing gamification techniques can make learning enjoyable and memorable.
- **Practical Approach:** Theoretical activities, which may be perceived as boring, should be minimized. Practical, hands-on activities should take precedence, allowing students to actively engage with STEM concepts, fostering a deeper understanding.
- **Target Audience:** The age and educational level of the students should play a crucial role in activity selection. Tailoring activities to match the students' developmental stage and educational background ensures relevance and effectiveness.

To guide the selection process effectively, several questions should be addressed:

- **Goal of the Initiatives:** The primary goals of the initiatives must be kept in mind when choosing activities. These activities should emphasize the importance and applicability of STEM disciplines while targeting specific knowledge and skills acquisition.
- **Activities that fulfill the main goals:** Activities that strike a balance between challenge and enjoyment, demonstrate real-world applications, and focus on technology-related themes have proven effective in achieving the main goals.
- **Appropriateness for Each Audience:** Activities should align with the students' age, educational level, and professional fields. Younger students may benefit from activities showcasing real-life applicability, while older students may seek activities related to their future careers.
- **Stimulation Based on Age and Studies:** The age and educational background of students play a significant role in activity selection. Dynamic technology-focused activities, such

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as robotics and programming, are well-suited for secondary-level students. However, VET (Vocational Education and Training) students may require activities that directly relate to their professional fields.

The engagement of motivated and committed students and teachers is crucial. Students should possess a genuine interest in STEM fields and a willingness to explore them further. Efforts should also be made to address the gender gap in STEM by encouraging participation from traditionally underrepresented groups, such as women.

In conclusion, selecting STEM-related activities for students should prioritize diversity, real-life applicability, sustainability, fun and practicality. These activities should be tailored to the target audience's age, educational level, and professional interests. By considering these factors, we can create engaging STEM experiences that inspire students and prepare them for future educational and career opportunities.

4.4.2 Choice of materials and logistics

Selecting appropriate materials and planning logistics are crucial aspects of developing activities related to STEM fields. As teachers there are several factors we should consider when preparing activities for students in these areas. Here is a comprehensive overview of the importance of material choice and logistics planning:

- **Incorporating Robotics and Logical Thinking:** Activities involving robotics, coupled with logical thinking and mathematical challenges, should be integral to STEM camp agendas. Robotics not only sparks curiosity but also promotes problem-solving skills and creativity among students. These activities provide hands-on experience in STEM subjects.
- **Gamification Techniques:** To mitigate students' fears and enhance their motivation, it's essential to approach mathematics and science fields through gamification techniques. By blending education with enjoyment, students can learn while having fun. Simple and creative science kits and mathematical games can be valuable tools in summer camps, making learning engaging and interactive.
- **Facility and Equipment Requirements:** Adequate facilities with necessary equipment and resources should be secured for all participants. Beyond computers and digital devices, consider providing tools like 360 cameras, VR (Virtual Reality) headsets, video cameras, and editing software for virtual tours. These tools enhance the learning experience by

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offering immersive and hands-on opportunities.

- **Specific Tools for Robotics:** If robotics activities are included, ensure that you have the requisite tools for development and programming. Tools and platforms such as Arduino, Virtual Reality, Artificial Vision, AppInventor, Unity, drone racing (Parrot), and Micro:bit robotics are popular choices in STEM training. Access to these tools facilitates practical learning and experimentation.
- **App Development for Real Problem-Solving:** Engaging students in developing applications to solve real-world problems can be highly motivating. Whether addressing social inclusion or scientific challenges, app development not only imparts technical skills but also nurtures soft skills such as creativity, teamwork, proactivity, and effective communication. This approach combines technical proficiency with a heightened awareness of societal issues.
- **Programming and Robotics Championships:** Organizing programming and robotics championships can foster logical thinking, problem-solving abilities, creativity, and healthy competition among students. These events encourage participants to apply their knowledge and skills in real-world scenarios, further enhancing their confidence and enthusiasm.
- **Industry Visits:** Offering students the opportunity to visit real companies provides invaluable firsthand experiences. Witnessing how these organizations operate immerses students in the professional world, inspiring them to pursue STEM careers. Industry visits can be a transformative experience, offering insights into the practical applications of STEM disciplines.

In conclusion, meticulous consideration of materials and logistics is essential for the success of STEM-related activities. By incorporating robotics, logical thinking, and gamification, providing appropriate tools and equipment, encouraging app development for real problem-solving, organizing championships, and facilitating industry visits, educators can create a dynamic and engaging learning environment. These efforts not only impart technical knowledge but also nurture essential skills, empowering students to excel in STEM fields and contribute to a technologically advanced and innovative future.

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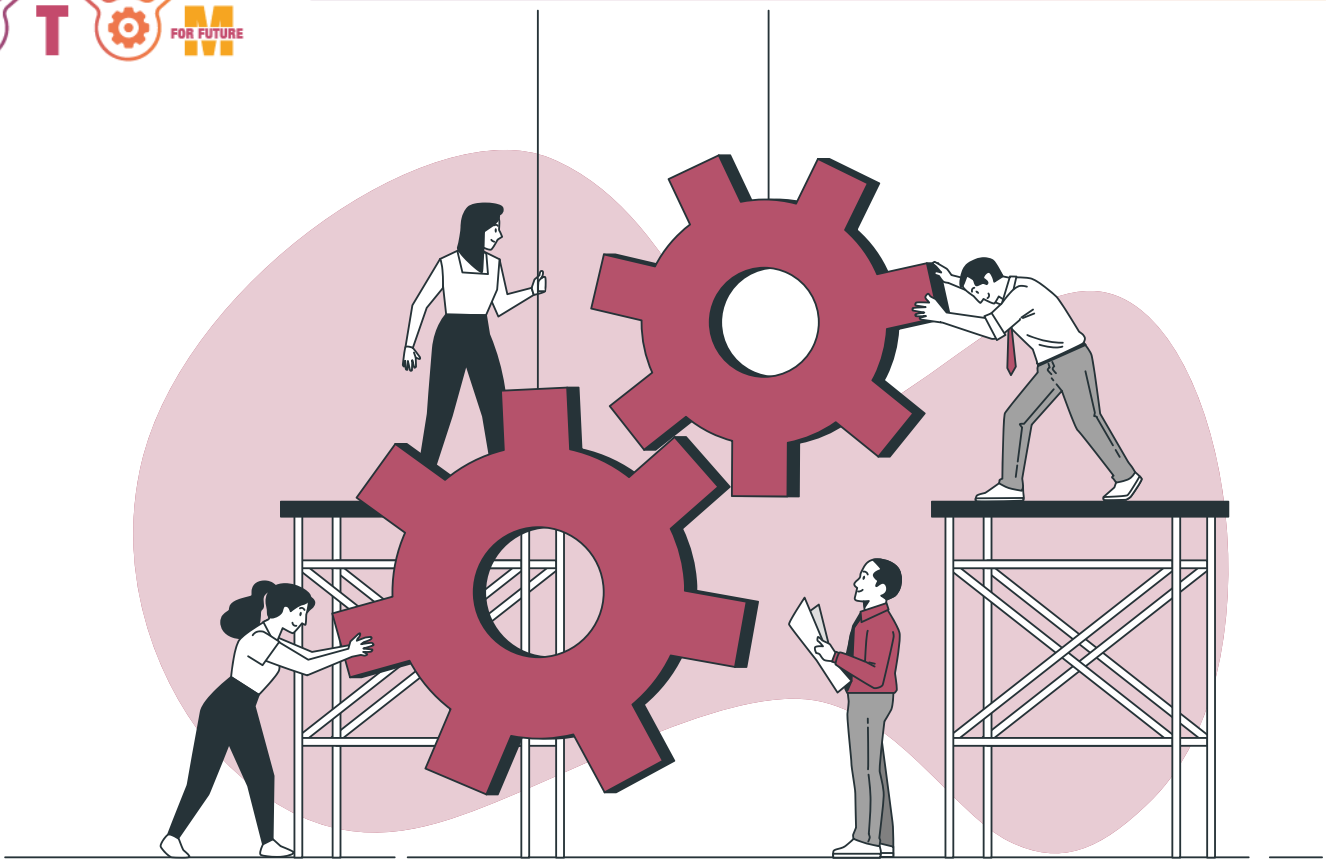

5.
Tools and Results

Evaluation serves as a cornerstone in the realm of program effectiveness and improvement, particularly in the context of STEM education initiatives. This multifaceted process involves the assessment of various components, each contributing to a comprehensive understanding of the program's impact.

To begin with, evaluating STEM skills is paramount. The establishment of specific, measurable goals aligned with program objectives forms the basis for effective assessment:

- **Assessing STEM Skills:** To gauge effectiveness, we have to set specific, measurable goals aligned with program objectives. Evaluation methods may include tests, practical activities, observations, and other tools. This allows students and teachers to track their STEM knowledge and skills and measure progress. Pre-and post-activity questionnaires are crucial for measuring skill growth, as outlined in Project Result 2 of the STEM for Future project.

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- **Evaluation of changes in STEM perception and self-efficacy:** crucial to measuring the effectiveness of the carried out activities. It is important that STEM camp participants acquire a correct understanding of the real meaning and importance of STEM education in order to make more informed decisions for their future. Furthermore, it is important to evaluate changes in the perceived self-efficacy about STEM disciplines, which often is one of the main reasons that keeps young students, especially girls, away from a future choice in these fields.
- **Measuring Satisfaction:** Evaluation of satisfaction relies on clear and specific criteria. Tools should enable students and teachers to voice their opinions on the STEM program, organizational aspects, and activity quality. Valuable feedback helps improve the program.
- **Assessing Impact:** Post-activity evaluation should also consider the impact on participants' post-diploma training and career choices. This involves using an additional questionnaire, administered six months after their camp participation, to explore shifts in orientation, motivations, and choices.

In essence, evaluation is a pivotal element for ongoing enhancement. It provides insights into activity strengths and weaknesses, guiding the development of strategies and subsequent actions.

For evaluation and assessment in the STEM camp context, several tools were developed, including:

- **Initial Implicit Association Test (IAT):** The IAT is a fundamental tool for measuring changes in STEM perception and self-efficacy. It helps participants identify their implicit biases and associations related to STEM fields. By administering this test before and after the camp, the program can gauge how participants' perceptions have evolved. For instance, participants may start with certain stereotypes or misconceptions about STEM, and the IAT can track if these biases have diminished because of their camp experience.
- **Main Questionnaire:** The main questionnaire is a comprehensive assessment tool with various categories designed to gain insights into multiple aspects of participants' experiences:
    - **Background Information:** This section gathers general information about the participants, such as their nationality, school, age, and parental involvement in STEM.
    - **Computer Science Perception:** It explores participants' beliefs about ICT professionals and their understanding of the ICT world. This section helps identify

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any preconceived notions and how they may have changed.

- **Future Choices:** This section delves into participants' intentions regarding future studies and career choices. It captures whether the camp influenced their decisions and how.
- **Gender Stereotypes:** This part investigates participants' beliefs about gender-related obstacles in STEM. It helps assess whether the camp has had an impact on participants' awareness of gender stereotypes in STEM fields.
- **Satisfaction:** The satisfaction section is vital for understanding participants' overall contentment with the STEM camp. It allows participants to express their opinions on the program, organization, activity quality, and offer constructive feedback for program improvement.

- **Follow-up Questionnaire:** The follow-up questionnaire plays a crucial role in evaluating the medium to long-term impact of the camp on participants' choices. Administered around six months after the camp, it revisits their future study and career decisions. By comparing their responses to the initial questionnaire, the program can assess whether the short-term impacts have translated into sustained changes in participants' orientations and motivations.
- **Semi-Structured Interviews for STEM Camp Teachers:** These interviews provide a deeper understanding of the camp's effectiveness from the perspective of the teachers and trainers involved. The semi-structured format allows for in-depth discussions about various aspects, including:
    - **Process Evaluation:** Teachers can provide insights into the strengths and weaknesses of the assessment tools and suggest improvements.
    - **Methodology Assessment:** Teachers can share their views on the camp's structure, activity planning, and the development of both hard and soft skills among participants.
    - **Activity Impact:** Teachers can provide firsthand observations on how the camp activities have affected the participants' learning and growth.
- **Satisfaction Questionnaire for Teachers and Trainers:** This specific questionnaire is designed to measure the satisfaction of the teachers and trainers who were actively involved in the STEM camp. It aims to understand their level of contentment with their roles and contributions to the camp's success. Their feedback can be instrumental in refining the training and support provided to instructors for future camps.

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The culmination of these efforts involves a meticulous analysis of the obtained results. Utilizing regression analysis as a chosen methodology, the examination focuses on the intricate relationships between camp characteristics and desired outcomes. This method proves invaluable, especially when dealing with multiple iterations of camp activities, allowing for the identification of influential design choices.

In the preliminary data analysis phase, our focus was on sifting through the collected responses to ensure the removal of incomplete submissions. Through this process, we successfully filtered a dataset consisting of 67 unique entries. These submissions spanned five different camp iterations, including four national camps and one conclusive international edition, each providing a distinct perspective on the impact of our extracurricular STEM activities.

Within this rich dataset, a balanced gender representation was evident, with 32 male participants and 34 females contributing their unique insights. Furthermore, the class sizes for these field iterations were around an average number of 20. Notably, three out of the five camp iterations were distinctly centered around activities involving the making approach.

The initial analysis modeled the relationship between various factors from participant background and initiative features and the likelihood of participants pursuing a STEM path after the end of the camp experience. Notably, the likelihood of choosing a specific career depends on many factors not easy to track with a questionnaire, explaining the marginal fit of the model. Yet some important suggestions may be extracted.

Particularly, the gender of participants, being male in this specific case, emerges as a significant predictor of their likelihood to choose a STEM path. In fact, being male increases the likelihood of STEM pursuit by approximately 30%. This confirms that male participants are more inclined toward STEM fields. The inclusion of STEAM activities and the no-code approach as variables allows us to evaluate their effects on participants' choices. Furthermore, variables related to specific camp experiences, such as the main topic of making, camp satisfaction, and team belonging, are considered. For instance, a correlation between camp experience liking and inclination toward STEM suggests that a positive experience leads to an increase of approximately 19% in the chances to choose a STEM path in the future.

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Shifting the focus of the analysis to the variable measuring the level of enjoyment or likeness of camp activity, it is possible to infer a correlation with the possibility of the participant expressing their creativity and satisfaction towards the project being developed. In fact, the variable "camp_project_satisfaction" is also positively and significantly associated with camp liking. A positive evaluation of camp project satisfaction increases by approximately 31% the chance of having a higher overall satisfaction score, suggesting that satisfaction with camp projects influences overall liking. Moreover, the variable "express_creativity" has a positive and statistically significant effect, indicating that participants who feel that the camp activity allowed them to express their creativity have roughly 24% more possibilities to like the camp more. To further explain this result, a specific regression analysis was employed on the "express creativity" variable leading to two main results. The first is related to the STEAM approach in activities, an approach that redefines the emphasis of STEM education towards a higher quality of inclusive thinking, encouraging holistic approaches that incorporate the arts to enrich scientific and technological exploration. In our case, the STEAM approach has a positive influence on the creativity variable.

The second result, even though with a more marginal effect, suggests that employing activities that use block-level coding languages also contributes to increasing the chance of a higher score on the creativity variable.

On a conclusive note, regarding regression analysis, focusing the analysis on variables connected to participant background in correlation with their likelihood to choose a STEM path in the future prior to the start of the camp experience shed some light on pre-existing interest. Specifically, personal belief in the relationship between job occupation and having a family plays an important role. In fact, those who believe that having a family fit well with a job in the STEM field are more likely to include STEM careers in their future choices. Conversely, there is a negative correlation between beliefs related to having a family in other job positions and an inclination towards STEM. In a more general context, camp activities are confirmed to be effective in enhancing participants' comprehension of what STEM education comprises. In Figure 1, results to the question "Now I better understand what STEM education is" are shown. In the figure, the answers ranging from "I strongly disagree" to "I strongly agree" have been coded into values ranging from 1 to 5. The left graph shows percentages of respondents choosing a specific answer, with the average highlighted with a red vertical line. While the right graph shows the respondent sex.

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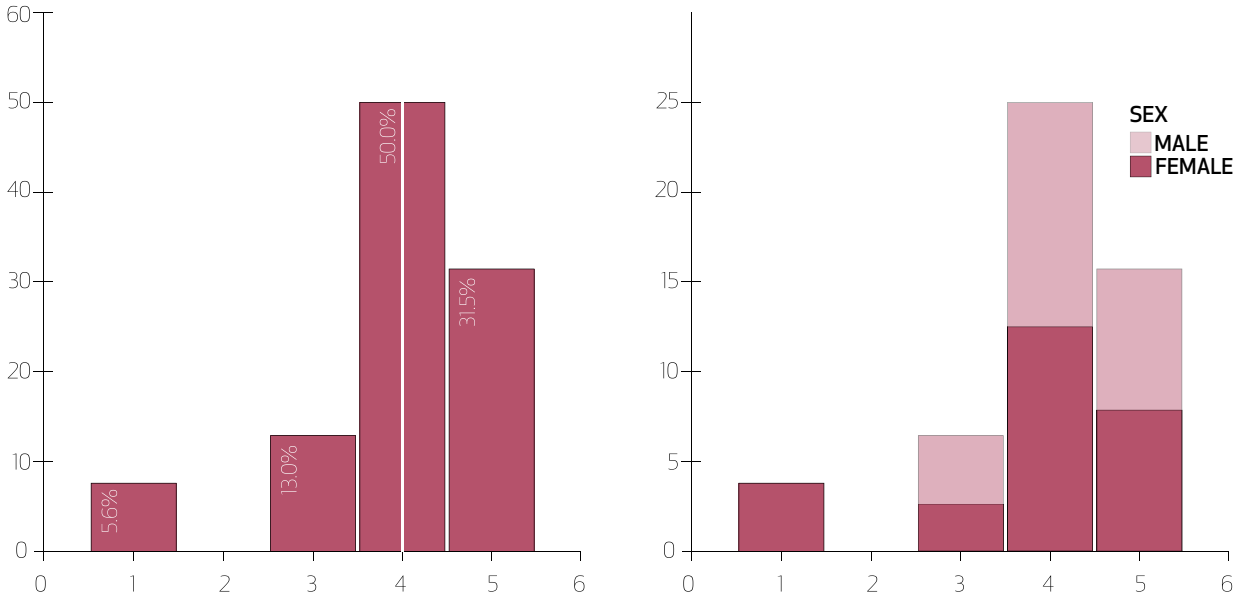

Figure 1. STEM understanding

Several open-text responses have been documented to offer firsthand insights and perspectives directly from the participants themselves:

- Before I thought it was kind of a geeky/freak issue, mostly for boys or anti-social people, but I have changed my mind.
- I thought it was about something not very interesting, but the experience was beautiful, and I learned a lot of stuff.
- Before, I didn't get much about what STEM was, now instead, after working together, it is clearer. Very useful experience, I learned a great load of new stuff thanks to this activity.

The substance of these excerpts is corroborated by the findings of a question regarding whether participants believe they have gained new insights into STEM concepts. In Figure 2, responses to the question "I learned new things about STEM" are presented. The answers, ranging from "I strongly disagree" to "I strongly agree," have been assigned values from 1 to 5. The left graph illustrates the percentages of respondents selecting a specific response, with the average marked by a red vertical line. Simultaneously, the right graph displays the gender distribution of respondents.

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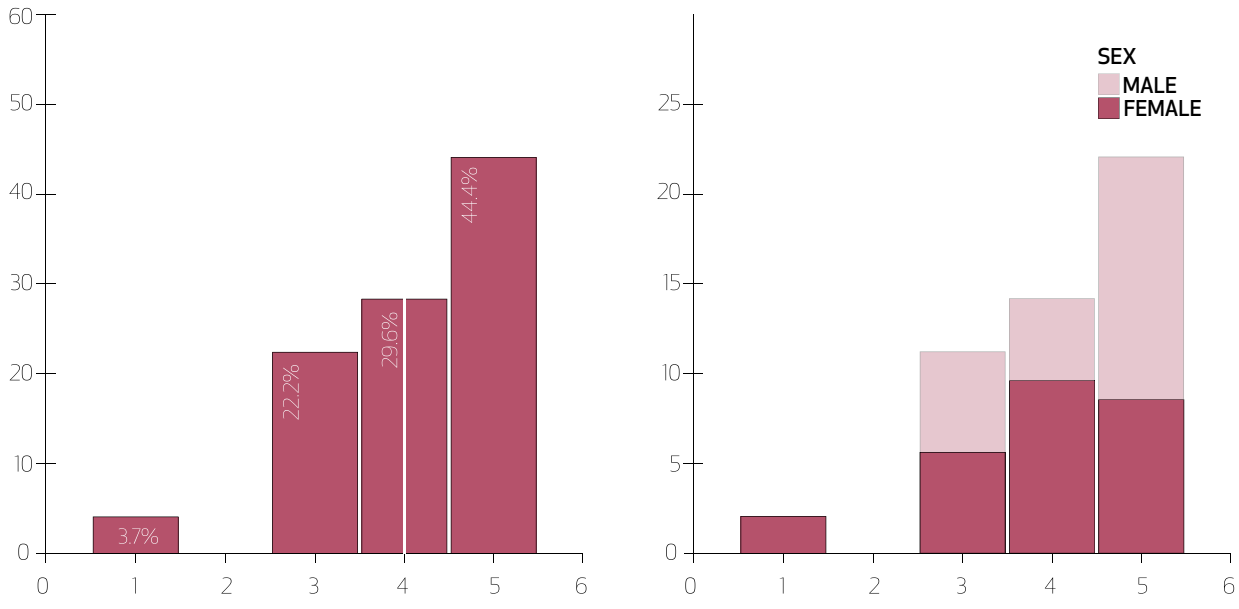

Figure 2. Learned new things about STEM

Finally, certain open-text responses pertaining to the section addressing future choices provide us with insights into the outcomes of implemented activities, thereby affirming the results of our analysis:

- Although I am not going to change my mind, I would like STEM to become part of my future working life because I can see its utility and importance.
- I considered committing to a more STEM-oriented future.
- I didn't know in which field searching for a job, but now I'm more oriented.
- My opinion changed for the better because I saw the real application and useful things that can be done with STEM.
- After the camp, I can think about the STEM discipline with a more positive perspective, and I can think of a new way to use it in my profession as an early year educator.

The evaluation of STEM programs, anchored in a robust framework of assessment tools and methodologies, provides a roadmap for continual improvement. Insights gained from thorough analyses contribute to informed decision-making in program design, ensuring a lasting impact on participants' perceptions, choices, and future endeavors in STEM fields.

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Regarding teacher satisfaction questionnaire, their responses indicate a high level of satisfaction, as evidenced by consistently positive ratings on various aspects. Teachers expressed their enthusiasm for teaching during the camp, feeling part of the staff team, and satisfaction with the project carried out. Additionally, teachers affirmed the satisfactory inclusion of both STEM and soft skills-related activities in the camp. As we delve into the specific aspects of their likes, dislikes, and suggested improvements, the collective positive sentiment sets a positive reaction to the overall organisation of the "STEM for future" camp.

Regarding open feedback responses, they highlight a consistent positive sentiment toward the students' involvement in the STEM camp, with a common appreciation for their motivation and awareness of STEM disciplines. The most liked aspects include dealing with motivated students. Also, some challenges were noted, such as the level of engagement of few participant not meeting expectations, the difficulty in managing groups during STEM activities, and concerns about some aspect of logistics. Suggestions for improvement include extending the camp length, providing more advanced information to participants, and incorporating more robotics and science activities.

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6. Best practices

The STEM camps realised as part of the European project STEM for Future were collaboratively developed and implemented by partner organizations throughout the project's duration. The implementation of such a project necessitates the consideration of various factors, as delivery methods employed in one country may not always align with those of others. Moreover, noteworthy ideas emerging from national camps may offer valuable insights for inclusion in future camps.

This chapter aims to give an overview of the best practices that were collected during the project. They refer to actual experiences of the partners, as well as the elements considered important by the students involved in the activities.

6.1 Rules and Roles

The STEM camps explored the concept of roles and responsibilities within each group. Group work is an educational approach that involves several individuals working together to achieve a shared goal. Within a group, each participant assumes a specific role and performs tasks in line with his or her skills and abilities.

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This method offers several advantages, especially when working with young learners. Collaborative group work fosters the development of a range of social and cognitive skills (e.g. the ability to cooperate effectively, to actively listen to others, to make collective decisions and to solve challenges creatively). Furthermore, assigning distinct roles and tasks to each member not only improves individual skills, but also cultivates a sense of responsibility for the group as a whole.

For young people, engaging in group work can be very useful in helping them identify roles that match their interests and aptitudes. Through group work, young participants can explore their strengths and weaknesses, identify areas of passion and further develop their talents. Group work serves as a means of self-discovery, enabling them to direct their interests towards specific areas of expertise that can influence their future careers. For example, a participant responsible for group communication might discover a talent for marketing or advertising, while another who is involved in programming might discover a passion for computer science.

During the camps conducted as part of the STEM for Future project, different approaches to small group collaboration were adopted:

- In the Italian camp the methodology used was Project Based Learning. Participants were organised into small groups, each simulating different departments within a company, such as "hardware", "software", "biology", "CO2 management" and "marketing". These groups worked collectively towards a common goal: to design and build an intelligent greenhouse.
- The camp held in Spain adopted a challenge methodology approach, in which students were divided into small groups and challenged to create an inclusive foosball game using STEM areas.
- Like the Spanish camp, the Portuguese camp also used the challenge-based methodology, but from a different perspective: each day was dedicated to a topic and was developed in collaboration with companies in the areas where students were able to visit facilities and develop their projects in a real work context.
- The camp in Estonia developed a teamwork methodology in which the young people carried out various activities in small groups, developing their technical and social skills.

6.1.1 How to delegate the roles and responsibilities of participants

There are at least two effective approaches to assigning roles and responsibilities within a project:

- **Skills-Based Alignment:** Start by assessing the skills and knowledge of each student

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participating in the project. For instance, if the project involves building a robot, identify students with expertise in electronics, IT, mechanics, design, and related fields. This way, roles can be assigned to individuals based on their specific skills and abilities.

- **Interest-Driven Engagement:** Encourage participants to choose roles and tasks that align with their interests and preferences, even beyond their existing knowledge and skills. This approach aims to empower individuals to feel valued and motivated to contribute actively to the project's success and explore fewer familiar areas with enthusiasm.

In both cases, the key is to ensure that every participant plays a significant and active role in the project. They should actively engage in group decisions, project execution, and contribute their ideas and skills. This approach fosters a sense of value and motivation among participants, motivating them to work toward the project's success. Therefore, it is crucial to implement inclusive and participatory methods.

Furthermore, it is important to define each role's tasks and responsibilities clearly within the project. This clarity helps prevent confusion and misunderstandings within the group and keeps participants focused. Collaboration among group members should be encouraged so that everyone can contribute and work together to achieve project goals. Regular meetings can be scheduled for students to discuss their progress, share challenges, and collectively find optimal solutions.

Periodically reviewing the progress and task distribution is also essential. This step ensures that the project stays on track and that each student effectively fulfills their role. It promotes collaboration within the group, making each student feel involved and valued, and ensures that the group's work proceeds smoothly and effectively.

Taking the example of the Italian STEM camp, each group's members were assigned specific roles such as secretary, researcher, time manager, coordinator, and deputy. Each role came with a set of tasks and responsibilities (e.g., the coordinator was responsible for directing group activities, coordinating with other group coordinators to assess the project's status regularly). Periodically, participants were encouraged to reflect on their assigned roles to determine whether their skills matched the required tasks. They were also given the opportunity to switch roles based on their personal aptitudes and characteristics. This approach empowered participants to choose roles that best suited their individual attributes.

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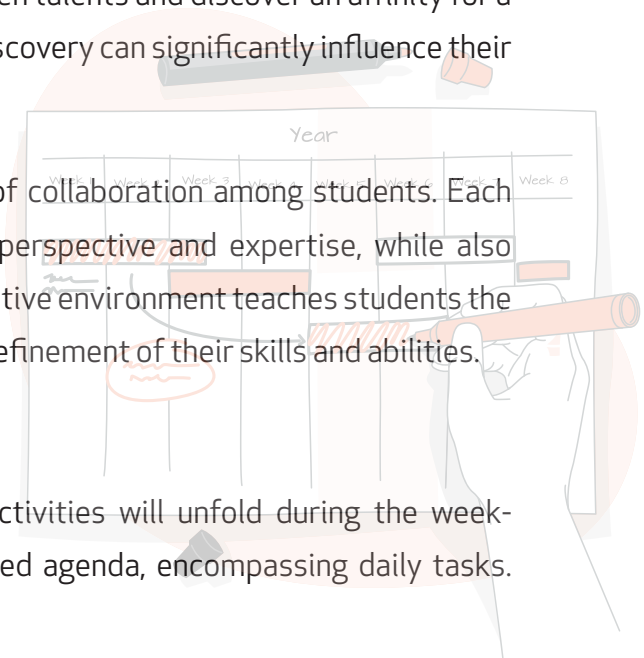
6.1.2 Importance of changing the roles

Role rotation within a group dynamic offers numerous benefits, fostering positive interdependence, engagement, and cultivating a shared sense of responsibility for the group's success. Continually shifting roles ensures that students remain actively engaged in the learning process. Additionally, role rotation provides an opportunity to learn and experience firsthand the micro-behaviors and attitudes associated with each role.

The practice of changing roles throughout an activity holds significant importance as it allows young people to gain a comprehensive understanding of the project while simultaneously developing a diverse range of skills and abilities crucial to their growth. When students take on various roles within a project, as is the case in a STEM camp, they are confronted with distinct tasks and responsibilities that demand specific skills and knowledge. This multifaceted approach empowers each student to enhance and diversify their skill set, thereby improving their problem-solving, critical thinking, and creativity skills.

Furthermore, role rotation aids in the development of flexibility and adaptability, both of which are indispensable qualities in both professional and personal life. By acquiring new skills in different contexts and facing fresh challenges and situations, students learn to adapt and thrive in various scenarios they may encounter.

Role rotation also encourages students to explore their own inclinations, interests, and passions. As they sample different roles, students may uncover hidden talents and discover an affinity for a position they had never previously considered. This self-discovery can significantly influence their future academic and career choices.



Lastly, the practice of changing roles nurtures a culture of collaboration among students. Each student has the opportunity to contribute their unique perspective and expertise, while also learning from the experiences of their peers. This collaborative environment teaches students the value of teamwork, effective communication, and further refinement of their skills and abilities.

6.2 Presentation of the activities

To facilitate students' comprehension of how various activities will unfold during the week-long camp, it's beneficial to furnish them with a structured agenda, encompassing daily tasks.

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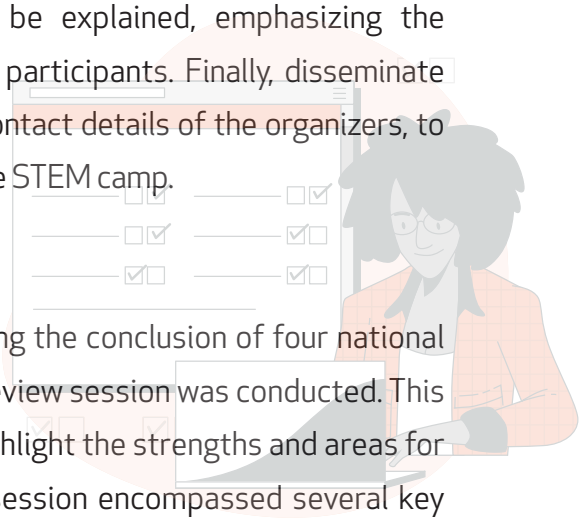
Additionally, providing them with a personalized calendar that allows customization based on their group activities and roles within the group is advantageous.

Furnishing students with an activity overview and a detailed agenda serves several purposes. Firstly, it enhances their comprehension of the planned activities, their objectives, and the skills they will acquire throughout the STEM camp. This understanding enables them to prepare adequately, ensuring active and effective participation. Secondly, it encourages student involvement in activity planning, fostering a sense of belonging and motivation. By comprehending how activities are organized and how their tasks align with those of their peers, students become more responsible and committed to the project. Lastly, a detailed agenda facilitates the identification of students' preferences and needs. If particular activities pique their interest, more time can be allotted, or the agenda can be adjusted to accommodate their preferences. This demonstrates responsiveness to students' input, elevating their engagement and participation.

Equally important is to provide information on the materials and equipment required for planned activities. This enables students to prepare adequately and bring along necessary items if needed. Furthermore, elucidate how materials and equipment will be handled and how safety measures and resource availability will be ensured throughout the activities.

Additionally, it is imperative to present the rules and behavioral expectations that students are required to adhere to during the activities. These rules may encompass punctuality, safety protocols, responsible use of materials, cooperation with fellow participants, among others. Furthermore, the consequences for rule violations should be explained, emphasizing the commitment to maintaining the well-being and respect of all participants. Finally, disseminate essential organizational information to participants, including contact details of the organizers, to ensure seamless communication and coordination throughout the STEM camp.



6. 3 Suggestions from "Peers"

At the midpoint of the entire project STEM for Future, following the conclusion of four national camps conducted in Italy, Estonia, Portugal, and Spain, a peer review session was conducted. This session, supported by external expert consultants, aimed to highlight the strengths and areas for enhancement within the camp format. The outcomes of this session encompassed several key points:

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- **Activity Diversity and Utility:** Participants lauded the usefulness and variety of activities offered during the camps.
- **Preferred Activities:** It was evident that theoretical activities were less favored by most students, who expressed a stronger preference for practical, enjoyable, challenging, and engaging activities.
- **Popular Activities:** Activities involving robotics, artificial intelligence (AI), and programming garnered particular popularity among participants.
- **Teamwork Emphasis:** Students emphasized the importance of teamwork, and the utilization of pre-established groups and role rotation received positive feedback.
- **Soft Skills Development:** STEM Camps significantly contributed to enhancing various soft skills among students, including problem-solving, teamwork, communication, creativity, patience, and leadership.
- **Mathematics and Science:** While not universally favored by students, experts underscored the importance of including mathematics and science activities.
- **Company Visits:** Visits to STEM companies were well-received by students, providing them with valuable insights into real-world applications of STEM fields.
- **Application of Skills:** Students expressed the desire to apply the skills and knowledge acquired during the STEM Camp in practical settings.
- **Expert Proposals:** Recommendations from experts included developing apps to address real-world issues and enhance students' soft skills, employing challenge-based learning methodologies, organizing programming and robotics championships, and more.

These insights gleaned from the peer review session offer valuable guidance for refining and expanding future STEM camp initiatives within the STEM for Future project.

6.4 Suggestions from Students

As part of the peer review process, the Ambassadors' evaluations of the conducted camps were analyzed, leading to the identification of key observations and suggestions.

The Ambassador Interviews provide a complete insight into the experiences and reflections of participants from all partner countries who attended the National and the International STEM Camp. The interviews encompassed a range of questions, exploring into the participants' perspectives on the camp's strong points, their learning outcomes, and potential areas for improvement.

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Participants highlighted positive aspects such as cooperation, teamwork, and enjoyable sessions on programming, coding, 3D-design. The different daily activities, cultural learning, and interaction with people from different countries were also appreciated.

Collaboration and relationship-building emerged as strong points, fostering lasting connections and imparting lessons on effective collaboration, even in unfamiliar subjects. The immediate engagement in practical activities minimized moments of boredom and encouraged collaboration among all participants.

Suggestions for improvement included a desire to extend the international week and adding chemistry experiments. Some participants recommended maintaining the current activities program duration and enhancing communication through daily group discussions.

Regarding STEM disciplines, effective activities included group problem-solving, programming, and 3D-design, while challenges were found in Arduino activities. Participants expressed a newfound interest in STEM disciplines, citing the camp's positive impact on their perception of technical problem-solving and the concrete applications of STEM.

When envisioning the organization of a STEM camp, preferences leaned towards dynamic icebreakers, hands-on activities like 3D-design, 3D-printing, VR, and AI workshops. The importance of incorporating virtual reality to attract younger participants was highlighted.

To make STEM education attractive for everyone, suggestions included early integration of STEAM in schools, a blend of traditional learning with projects and study-trips, practical activities, and leveraging influencers to advertise STEM content effectively.

Participants emphasized the key role of fun in learning and the significance of varied teaching approaches. They expressed gratitude to the organizers, sponsors, and fellow participants, highlighting the enriching cultural exchange as a valuable aspect of the STEM camp. Overall, these interviews offer a rich narrative that captures the multifaceted experiences and insights of the Ambassadors, shedding light on the effectiveness and potential enhancements of STEM education initiatives. Here is a summary of the significant points derived from the Ambassadors' interviews and assessments:

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Level of satisfaction and learning:

- Participants expressed a high level of satisfaction, nothing personal growth in competencies and skills.
- They highlighted their creativity and the achievement of independent project implementation (self-learning).
- The usefulness and diversity of activities were widely commended.
- Fun was an integral part of the experience, alongside an increased awareness of STEM's importance.

Areas for improvement or focus:

- Ambassadors recommended providing more detailed information about camp content in advance to enhance participants' motivation.
- The popularity of theoretical activities was relatively low, warranting consideration for the International Camp.
- Programming and robotics activities were favored over science-related ones.

If students organized the International STEM Camp:

The following priorities were identified:

- Striking a balance between rigorous work and enjoyable experiences.
- Integration of all four STEM fields in a practical and user-friendly manner.
- Utilizing the Challenge-Based Learning methodology.
- A strong emphasis on technology, particularly robotics and programming activities.
- Continued group work, including pre-established groups and role rotation, which received positive feedback.

After the Camps:

- Participants reported a heightened understanding of STEM education, its significance, practical applications, and relevance to employability.
- Recognizing the interconnectedness of STEM fields for developing final products was a key takeaway.

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Soft Skills:

- Soft skills prominently cultivated during the STEM Camps included teamwork, creativity, decision-making, problem-solving, leadership, communication, and organizational skills.
- Ambassadors acknowledged the pivotal role of soft skills in their future careers, considering them as vital as hard skills in the workplace.
- The camps contributed to the improvement of several soft skills, including problem-solving, teamwork, communication, creativity, patience, leadership, among others.

STEM Education and Employability:

- Participants unanimously believed that STEM education significantly influences their professional lives, enhancing their employability and vice versa.

Gender Issues:

- Differing opinions existed regarding gender disparities in STEM fields. Some expressed concerns about the persistent gender gap and prejudices, while others were less apprehensive.
- There was a shared hope that gender-based biases would diminish in the future, emphasizing the importance of evaluating individuals based on their skills, not gender.

Making STEM Education Attractive:

Suggestions to make STEM education more appealing included:

- Broadening the appeal of STEM to all students, not just those stereotypically labeled as "smart" or "nerdy."
- Fostering an environment where students are unafraid of STEM subjects.
- Shifting toward real-life, problem-based STEM education to demonstrate practical benefits.
- Highlighting the real-world impacts of STEM areas on daily life.
- Leveraging celebrity endorsements and social media for dissemination.
- Promoting STEM through didactic presentations in public schools.

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Final Remarks:

Italian Ambassadors expressed a desire to actively participate in the design of the International Summer Camp and recommended involving them through brainstorming sessions to enhance their motivation and engagement in the process.

6.5 Difficulties and possible solutions

The gained experience has served a dual purpose for the partnership: it has enabled the collection of valuable best practices and has provided solutions to challenges encountered during the activities. Below, we outline some of the insights garnered:

Italian Camp

- **Recruitment Challenges:** One difficulty encountered was that of finding participants. The experience confirmed that identifying the target audience and promoting activities in a timely manner and well in advance is crucial, as it allows strategies to be modified if the initial approach proves ineffective.
- **Greenhouse Construction Timing:** A challenge emerged during the camp concerning the timing of greenhouse construction. On the penultimate day, it became evident that completing the physical construction of the greenhouse would require additional time. To address this, the STEM teacher took on the task of constructing certain parts of the greenhouse, ensuring the project's successful completion.
- **Differing Activity Durations:** Disparities in activity durations among groups were observed due to variations in the complexity of their greenhouse-related tasks. Some groups finished their assignments more quickly than others, resulting in challenges. Solutions were devised in two ways: groups that completed early were offered supplementary activities connected to their focus area or they temporarily aided groups that lagged, facilitating the progress of their activities.

Portuguese Camp

- **Practical and Dynamic Activities:** The National STEM Camp in Portugal revealed that students expected more practical and dynamic activities rather than extensive theoretical sessions. This experience highlighted the importance of aligning activities with student expectations, focusing on hands-on and team-based learning. To address this, organizers should avoid activities that demand significant prior knowledge or extensive information

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absorption within a short timeframe. If some foundational knowledge is essential, a Problem-Based Learning Approach can be employed. Here, students receive a problem to solve or specific questions to investigate, with organizers providing concise initial information on the activity's subject. Students can then collaborate, consult the internet, or use provided materials to acquire the necessary additional information.

- **Challenge Rules and Fairness:** Challenges posed during the National STEM Camp led to confusion among students regarding the rules and perceived unfairness in selecting winners. To mitigate these issues, clear and written rules should be communicated to participants. Furthermore, winners should be chosen based on predetermined criteria that students are informed about in advance. Involving students in the selection process and evaluating individual performance rather than team achievements can enhance fairness and minimize feelings of injustice.
- **Logistics:** Inadequate logistics planning presented challenges in transporting students to one of the camp's locations in Portugal. To improve this aspect, organizers should ensure that camp locations are accessible and not too remote. Providing or facilitating transportation for students is ideal, but at the very least, clear instructions regarding available transport options should be given. Additionally, organizers can offer guidance on nearby landmarks or reference points to help students navigate to the activity's location.

Spanish Camp

- **Attendance and Group Adjustment:** Regrettably, some students lacked commitment and failed to participate in camp activities as expected. To address this issue, we took the step of reorganizing the groups, excluding the absentees from consideration.
- **Role Distribution Flexibility:** The originally planned role distribution within the groups could not be executed due to unforeseen circumstances. Consequently, we decided to allow students to select roles they felt most confident and comfortable in, promoting a more adaptable approach.
- **"Dead Time" Between Activities:** A noticeable issue was the occurrence of idle time between certain activities, particularly during extended 3D printing processes following the design of table football figures. To optimize participants' engagement, we allocated a portion of one of the days to explore additional activities not initially included in the schedule, such as drone operation and experiencing Virtual Reality glasses.
- **Timing Challenges:** The timing of the STEM Camp posed a challenge, coinciding with the

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conclusion of students' exams, leaving them fatigued. Regrettably, this timing constraint was beyond our control and could not be altered.

Estonian Camp

- **Student Profile:** Most of our camp participants were Grade 1 students (10th grade), freshly transitioning from their foundational 9-year school education. At this stage, their primary focus lay in initiating their gymnasium-level studies, choosing academic tracks, elective courses, and the like. Consequently, considerations regarding post-high school education and career planning had not yet taken a prominent place in their thoughts. Typically, these discussions tend to become more significant during their gymnasium-level studies, involving more substantial conversations with teachers and parents.
- **Community and International Engagement:** Some of our camp activities involved tending to younger individuals, often in collaboration with Ukrainian students. These activities took on an added dimension as they encompassed the care of war refugees, set against the backdrop of the international situation, including the ongoing conflict in Ukraine. Needless to say, these aspects demanded special attention and dedication.
- **Challenging Weather Conditions:** It's important to note that the camp coincided with the hottest week of the summer, resulting in uncomfortably high temperatures both indoors and outdoors, which added an extra layer of difficulty to our program.

International Camp

Navigating the complexities of organizing an International STEM Camp, drawing from experiences gleaned from national camps, has unearthed both challenges and effective solutions.

- **Student Profile:** Despite the difference in age and educational and cultural background, the goals of the international camp were achieved. A pivotal strategy involved initiating from a common foundation, coupled with robust guidance from technical instructors to ensure a harmonious learning environment.
- **Change of Roles:** The condensed timeline of the international camp, spanning a mere five days, necessitated a pragmatic approach. Recognizing the constraints posed by the short duration, a decision was made to forego the rotation of roles initially established within the groups. This adjustment aimed to optimize the available time for focused engagement in STEM activities.
- **Time of the Activities:** Drawing from insights gathered during previous national camps,

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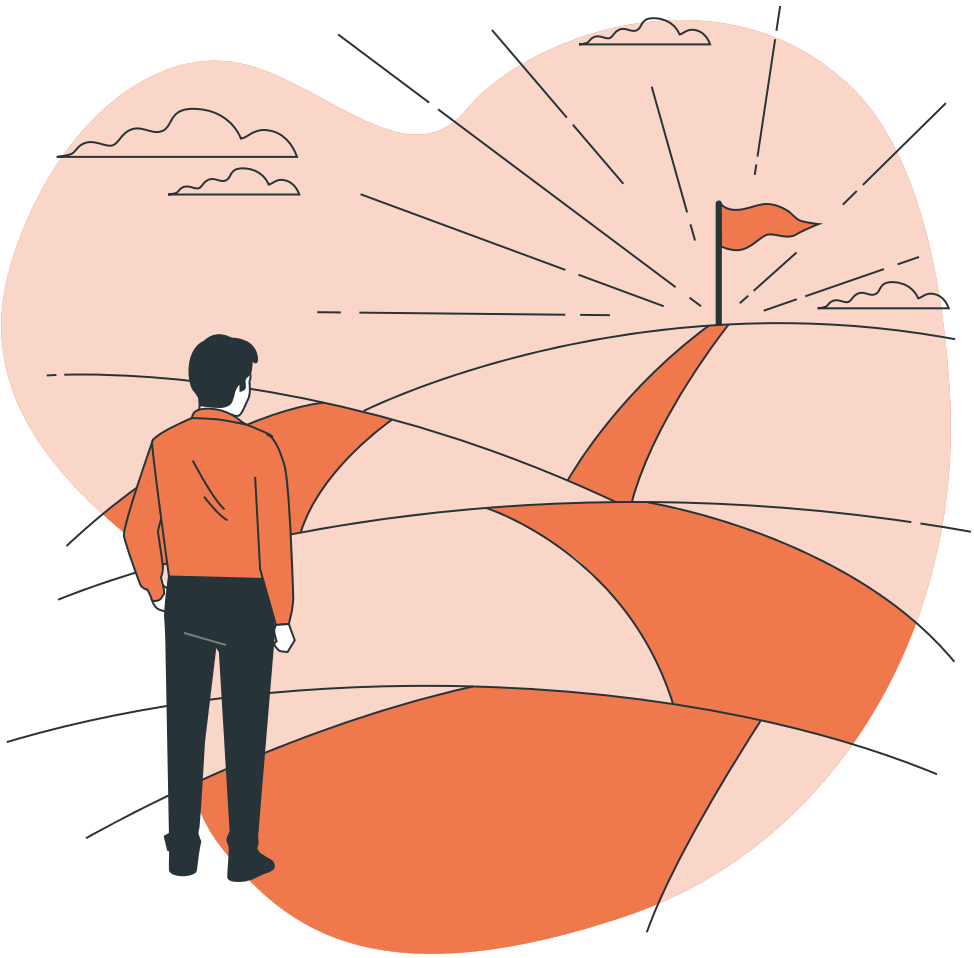
efforts were directed towards minimizing downtime between various activities, such as the intricate process of 3D printing. To achieve this, complementary sessions related to soft skills were seamlessly integrated. Notably, the efficient execution of the camp's schedule required the dedication of evenings for the printing of diverse 3D designs.

- **Logistics:** Insights from national camp experiences underscored the importance of meticulous logistical planning. Recognizing the imperative to have all necessary materials ready before the international camp commenced, organizers ensured that logistics were streamlined. This proactive approach facilitated a seamless flow of activities and minimized disruptions, contributing to the overall success of the International STEM Camp.



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7. Conclusion

The end of the Erasmus+ Project – STEM for the Future has resulted in the development of comprehensive guidelines aimed at enriching STEM education through interdisciplinary collaboration and partnership initiatives. Rooted in the experiences gained from National STEM Camps and an International STEM Camp, these guidelines stand as a valuable resource for educators and trainers in the STEM field.

The importance of introducing STEM fields in a compelling manner has been underscored, emphasizing their relevance not only in terms of employability but also in fostering essential skills through engaging and empowering activities. The inclusion of STEM subjects in school curricula, coupled with multifaceted approaches, has been identified as means to equip students with both hard and soft skills, making them more attractive to employers and prompting thoughtful reflections on inclusion and gender issues.

The guidelines provide a repertoire of used and tested methodologies, offering practical insights for designing effective and motivating STEM training activities. Notably, the incorporation of

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feedback from students, organizers, and teachers ensures a well-rounded set of recommendations that acknowledge successful aspects and areas for improvement.

Evaluation of STEM programs, as demonstrated through survey data and open-text responses, affirms the effectiveness of camp activities in enhancing participants' understanding of STEM education. The positive shifts in perceptions, highlighted by open-text responses and survey results, further reinforce the impact of these initiatives on participants' attitudes towards STEM disciplines.

Hopefully, these guidelines extend its value by addressing the difficulties encountered during the implementation of STEM camps and providing insightful solutions. Recruitment challenges, timing issues, and logistical hurdles were met with strategic adjustments and proactive planning, offering a guide for future endeavors.

The Ambassador Interviews also confirm the success of this initiatives and lessons learned from the International STEM Camp. Positive experiences of cooperation, cultural exchange, and practical learning highlight the effectiveness of these initiatives. Participant suggestions for improvement, spanning from extending program durations to incorporating additional STEM activities, also contributed to the ongoing refinement of STEM education initiatives.

In conclusion, these guidelines can be a catalyst for continuous improvement and innovation in STEM education. The shared experiences, challenges, and successes mentioned in this document intend to serve as a foundation for educators, organizers alike to shape the future of STEM learning, making it not just informative but truly transformative for students around the globe.

At the end of these guidelines, it is crucial to underline that they do not claim to offer a definitive solution. Rather, they serve as a valuable tool, fostering greater awareness and providing a strategic approach for teachers grappling with the orientation towards STEM disciplines. Recognising the complexity of the educational landscape, these guidelines are intended to stimulate a continuous process of improvement and innovation. The shared experiences, challenges and successes documented here aim to establish a solid foundation on which teachers can work together to shape the future of STEM subject orientation.

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8. Collaborative Horizons: Exploring Related STEM Initiatives

Concluding these guidelines, we take a forward-looking approach by exploring other projects dedicated to fostering STEM engagement. In this final part, we highlight related initiatives, promoting a collaborative vision to address the theme more effectively. Sharing these experiences aims to create a supportive network, expanding the impact of our efforts and contributing to shaping a common approach in promoting enthusiasm for science, technology, engineering, and mathematics in classrooms worldwide

"Ragazze Digitali" (Digital Girls)

Digital Girls, a unique initiative in Italy launched in 2013 and annually organised by two Italian universities, stands out as a remarkable and innovative experience among existing programs. The

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summer camp is designed to captivate the interest of high school female students, fostering their engagement in integrated ICT disciplines and contributing to the reduction of the digital gender gap. The camp experience provides a hands-on learning experience, emphasizing a collaborative and learn-by-doing approach. The program, offered entirely free of charge since its first edition in 2014, caters to students in the third and fourth grades of high school, requiring no prior coding or ICT skills. Over the course of four weeks, participants delve into the realms of coding, exploring applications in creative and innovative fields like video game programming and Arduino-controlled robot construction. Notably, the camp incorporates exposure to inspirational female role models from academia and industry, enriching the learning experience.

Since its inaugural edition in 2014, the camp has witnessed remarkable success, with over 500 enthusiastic participants. In its last edition, the initiative was held in six cities in the Italian region of Emilia Romagna, plus a city from Lombardia, hosting a total of 269 participants.

Recognized as a best practice in gender gap reduction by esteemed projects like Horizon 2020 Project EQUAL-IST, Digital Girls has made significant strides in promoting gender equality in ICT disciplines. The project consists of a unique initiative on the national and European stage, offering a rare combination of free, long-lasting, and tailored experience specifically designed for girls—an unparalleled contribution to the realm of ICT education. Furthermore, the initiative has gained international recognition, finding its place in the Case Study Library of the Observatory for Public Sector Innovation of Organisation for Economic Co-operation and Development (OECD) and is acknowledged in the 2021 She Figures report by the European Commission.

Form4te

A project of the Spanish Ministry of Education, sees the active participation of CIPFPM. and of national scope, see th. Form4te promoted and encouraged women's access to vocational training profiles directly or indirectly linked to STEAM vocational training qualifications. Likewise, vocational skills related to digitalisation were developed.

Industry 5.0

CPIFP is currently involved in the implementation of a regional project called Industry 5.0. Its main objective is to promote the acquisition by students and teachers of high-quality skills in technologies related to automated processes, applied robotics and the systems that make up Industry 5.0.

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ORIENTA-NET

ORIENTA-NET was a three-year project (2019-2022) financed by the Emilia Romagna Region, co-financed by the ESF. It was part of a Systemic action at territorial level coordinated by the Province of Reggio Emilia and it was implemented by Ifoa, leader of a broad partnership of local authorities https://www.orientanet-provincia-re.it/ . Ifoa led a partnership of 13 training institutions; the activities carried out within the project had the general objective of making available a system of guidance and support actions for the educational success of young people in the province of Reggio Emilia, structured in a plurality of integrated and complementary interventions and opportunities capable of responding to the needs of young people to be accompanied in their needs and in their educational and training paths.

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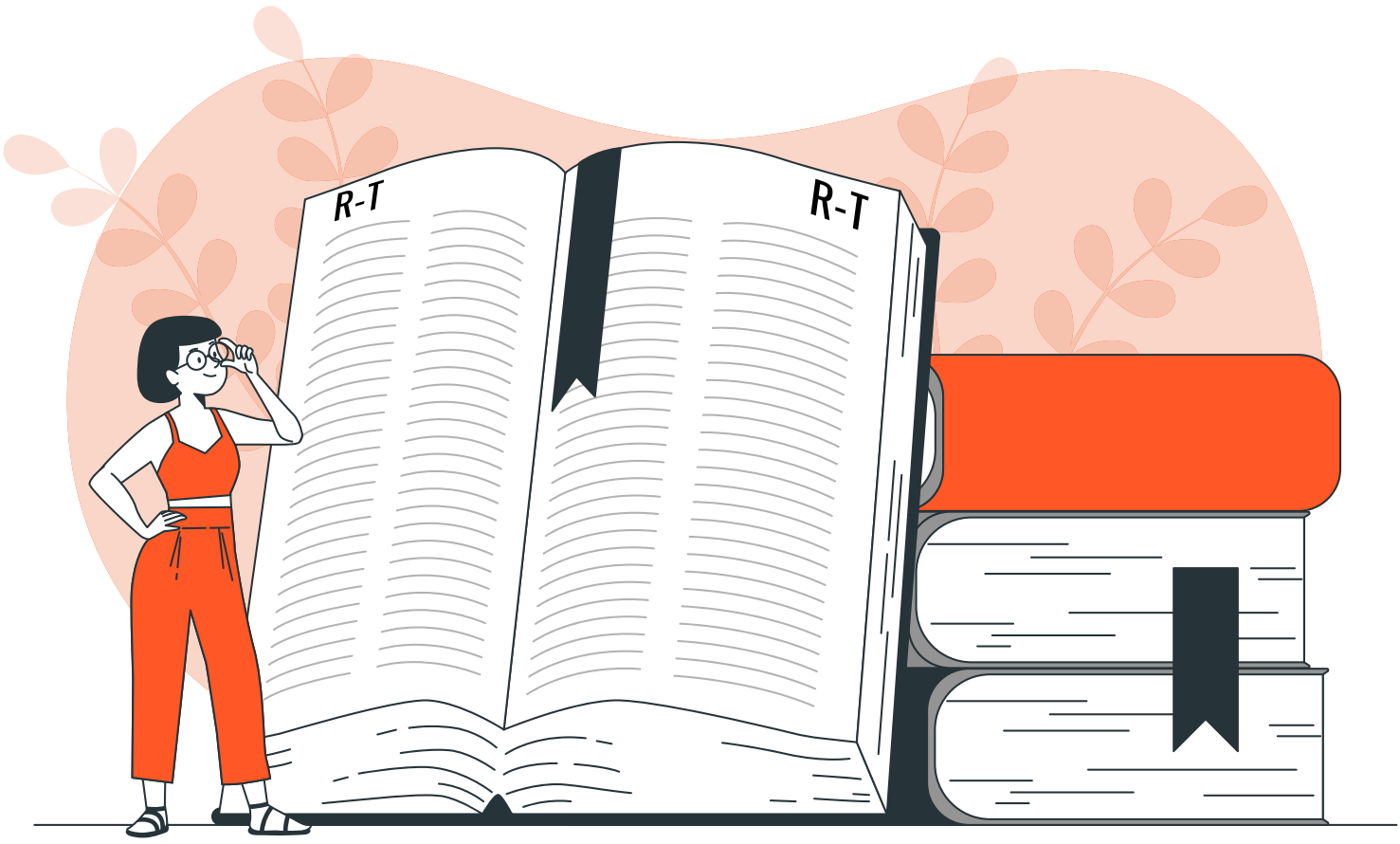

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