PROJECT RESULT 1

FORMAT FOR CONDUCTING FACE-TO-FACE AND DISTANCE STEM CAMPS

FOR FUTURE

Sapere utile
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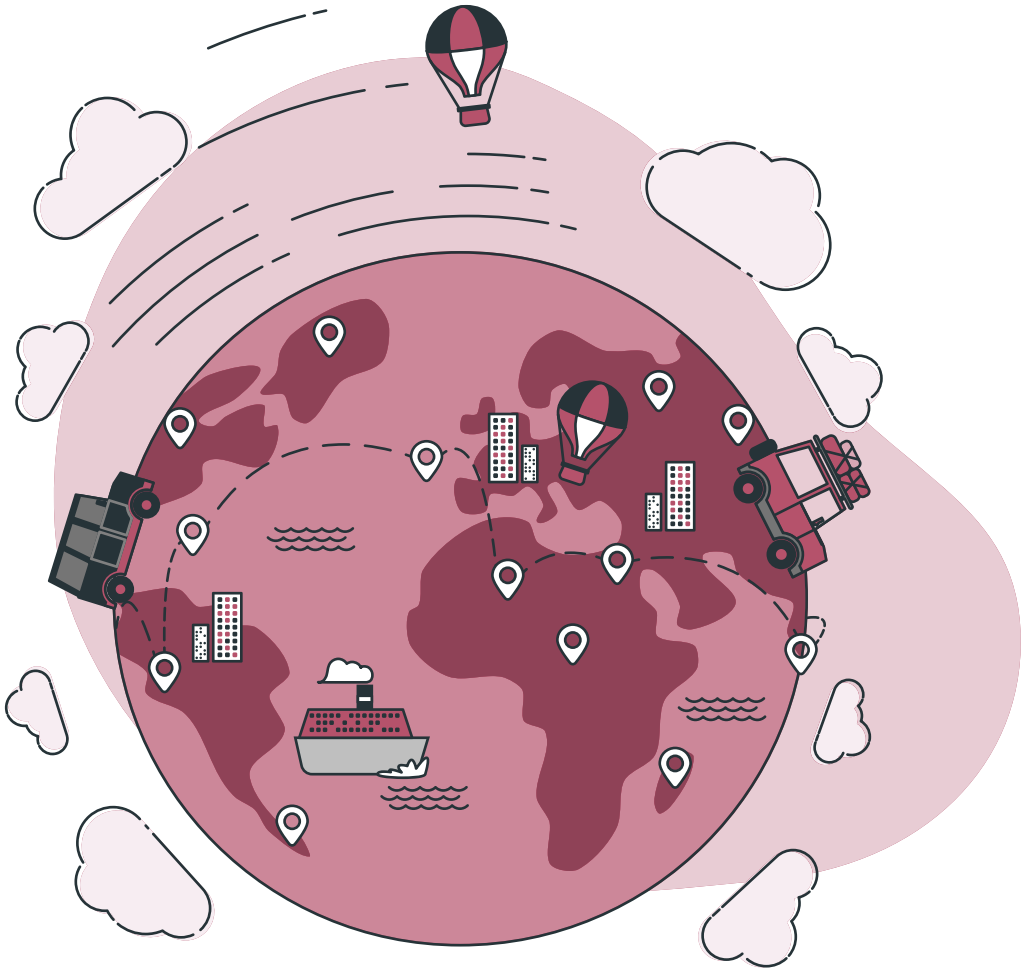

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Introduction

Over the past two decades, a discernible disparity has emerged between the supply and demand dynamics within STEM (science, technology, engineering, and mathematics) disciplines in Europe. Notably, a substantial portion of individuals completes their academic pursuits in fields with limited corporate demand. Conversely, certain sectors, particularly those aligned with STEM disciplines, witness an overabundance of supply relative to demand. This incongruity precipitates a host of challenges: individuals unable to secure employment within their designated sectors often gravitate towards positions necessitating lesser qualifications or transition into entirely unrelated occupational domains, thereby exacerbating wage mismatches.

Hence, it becomes imperative to focus on aligning the job requirements with the skills of young individuals. The educational and training decisions made throughout one's lifetime play a pivotal role in enhancing the prospects of securing future employment or engaging in a profession that corresponds with one's expectations. The discord between academic pursuits and the available job opportunities yields adverse effects on multiple fronts. On an individual level, this incongruence impacts earnings, job satisfaction, and overall motivation. For individual companies, the struggle to locate workers possessing requisite skills diminishes competitiveness. At a broader societal level, this mismatch signifies a suboptimal return on public sector investments in education, fostering sluggish productive growth and potentially increasing unemployment, thereby impeding overall economic growth and development.

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Instead of directing all students into pre-established educational pathways that may not allow for the cultivation of their skills, talents, and passions, it is essential to design educational interventions with an orientation focus. This approach enables students to better comprehend the structure of the labor market and discern future possibilities, while also providing information on the prospective job landscape. The lack of such information adversely affects all students, with a more pronounced impact on those who face limited opportunities to access labor market insights within their familial environment.

Another demographic significantly affected by the challenges in navigating towards STEM subjects is female students, often confronted with lingering prejudices that cast women as unsuitable for STEM disciplines. Additionally, female students encounter difficulties in identifying female role models to emulate in the pursuit of STEM education and careers. Consequently, even though both boys and girls exhibit similar levels of interest in STEM disciplines at a young age, a disproportionately small number of girls sustain and pursue these interests throughout academia and their professional trajectories.

Fostering meaningful skills for digital transformation is imperative for Europe to fully leverage the advantages of the digital revolution and maintain competitiveness in the global market. As of 2022, only 54% of the European population possessed basic digital skills, as per the Digital Economy and Society Index (DESI) 2022. Notably, the Netherlands and Finland lead in digital proficiency within the EU, while Romania and Bulgaria lag behind. Despite the growing demand for digital skills in the job market, a substantial portion of the EU populace lacks these foundational competencies.

The shortage of Information and Communication Technology (ICT) specialists persists, with a continuous increase in job vacancies as new roles emerge. In 2020, 55% of enterprises attempting to recruit ICT specialists encountered difficulties in filling these positions. Addressing this challenge stands as a priority across Europe, reflected in initiatives such as the Digital Education Action Plan (2021-2027) and The Digital Europe Programme, championed by the European Commission.

Potential remedies to enhance the current scenario involve initiatives aimed at empowering young individuals to acquire requisite skills and competencies. Implementing non-formal teaching methods is crucial, as they not only facilitate skill acquisition but also foster a critical understanding of the world, enabling active participation in economic growth. Proficiency in digital fields equips

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students with critical thinking abilities, innovative problem-solving skills, and prepares them for the dynamic nature of the evolving labor market.

Therefore, it is crucial to establish tools and pathways that assist students in making well-informed decisions. This involves providing them with a comprehensive understanding of the labor market, offering insights into potential future employment opportunities. Simultaneously, it is imperative to create environments, especially within certain subjects, that are non-judgmental and conducive to experimentation. This approach ensures that students feel free from scrutiny and are open to making errors without the fear of judgment or constant observation.

The establishment of a STEM program for students who have not yet committed to university or career trajectories holds particular significance, given that this phase in their lives marks a critical juncture for future decision-making. Students, during this pivotal period, are making choices that significantly shape their future paths. Those with access to a STEM program at this point are more inclined to pursue careers in these fields, subsequently expanding their job prospects and career opportunities. Engagement in such a pathway empowers students to cultivate skills and knowledge that prove beneficial across various domains of work, thereby enhancing their capabilities for a lifetime.

The incorporation of practical, laboratory, and project-based tools into didactics, especially within the STEM field, can yield numerous advantages. Firstly, it facilitates the active participation of both technical and non-technical subject teachers, fostering interdisciplinary collaboration during students' orientation phases. Secondly, the opportunity for students to apply the knowledge acquired in the classroom enables a more profound understanding of the subject matter, highlighting its practical implications. This hands-on approach not only enhances practicality recognition but also bolsters students' confidence, notably in dismantling gender stereotypes within STEM fields. In this form of training and guidance activity, establishing connections with companies during the construction phases of the program proves invaluable. This engagement serves to guide participants towards their educational, training, and professional futures with a more profound understanding of the dynamics within the respective industries. Furthermore, such collaborations can effectively mitigate biases and prejudices associated with STEM professions. By fostering relationships with companies, the program creates a platform to share and represent the narratives of women in these fields. This strategic approach enables female students to identify with and envision their

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own futures, contributing to the formation of a more inclusive and representative image of career possibilities in STEM for women.

The following is a model for the implementation of camps for the introduction to STEM subjects and choice orientation for students aged 16 to 20 on this type of pathway at university/post-graduate/career level.

The model is aimed at teachers and trainers who intend to implement introductory camps in STEM subjects. A methodological framework with a formative orientation has been delineated, providing a valuable tool for devising activities that effectively impart the fundamental principles of these subjects. The emphasis lies in illuminating their significance across diverse application contexts, including prospective future occupations.

The aim of the camps is to:

- update students' knowledge and gain awareness of the opportunities and skills required by innovation processes;
- approach STEM disciplines in an original and experiential way, stimulating the construction of their own educational pathway and counteracting gender stereotypes.

The activities are designed to form the backbone of an integrated system that connects institutions, schools, and the local community to promote technical-scientific culture and equal opportunities. This comprehensive approach will be executed by actively engaging teachers and trainers in the implementation process.

The following points aim to provide guidance for teachers and trainers, directing their focus towards necessary elements and essential steps in organizing a STEM Camp. While no mandatory steps are prescribed, as STEM camps must cater to diverse needs and specific objectives tied to the unique characteristics of the hosting country, certain fundamental steps are indispensable for ensuring the successful execution of the camp.

Within the framework, the term "summer camp" will be utilized to describe an extracurricular activity that can be conducted at any point in the year, outside of regular school hours.
This format has evolved through collaborative, multidisciplinary efforts as part of the

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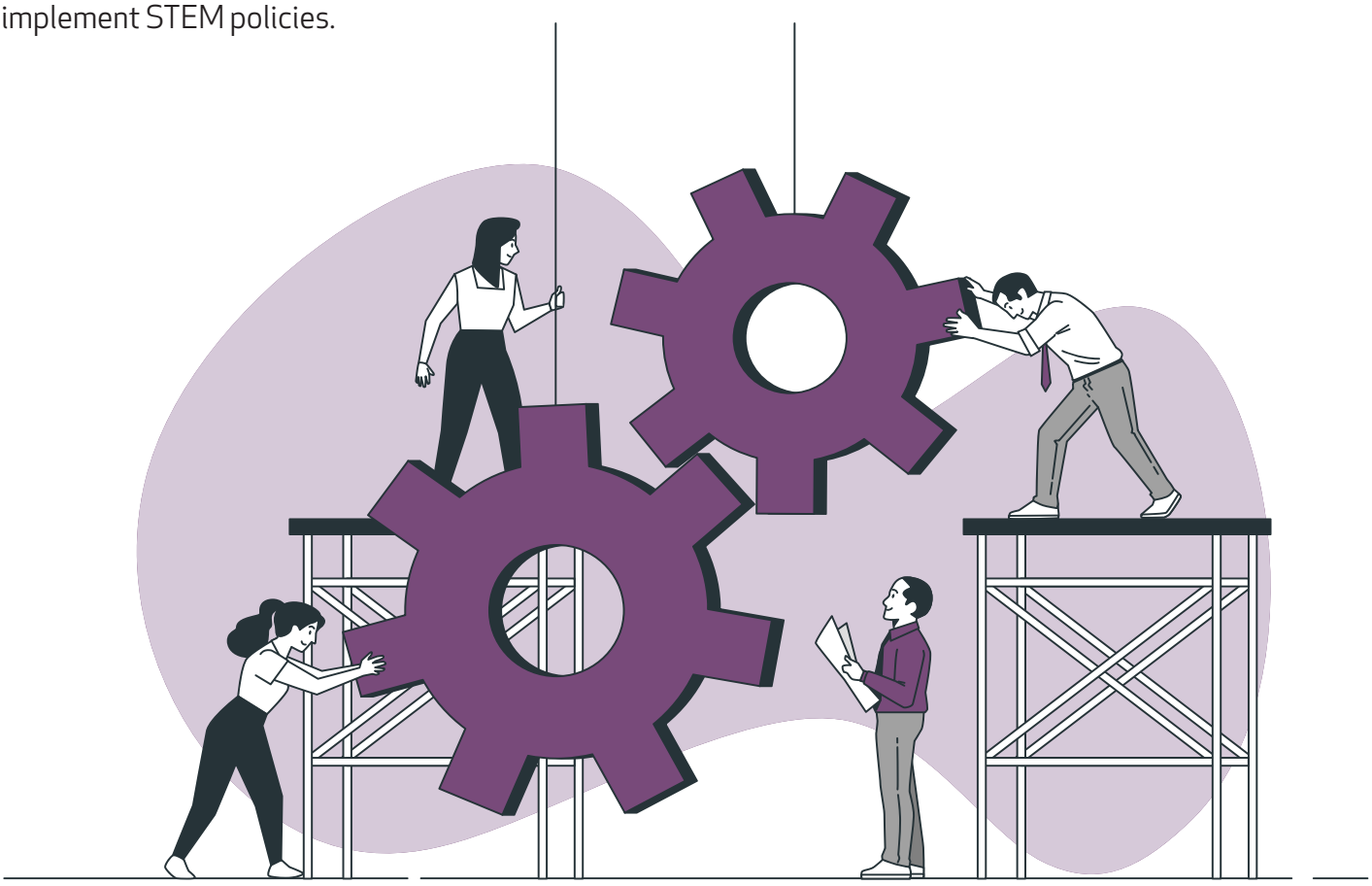
implementation of the Erasmus+ Project – STEM for Future. It was meticulously crafted by gathering feedback from National STEM Camps and an International STEM Camp, a collaborative initiative involving the following five partners:

- IFOA - Istituto Formazione Operatori Aziendali (IT)
- UNIMORE - Università degli Studi di Modena e Reggio Emilia (IT)
- Saaremaa Gümnaasium (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)

It represents the first Project Result (PR1) of the STEM for Future project and it is part, as an annex, of the guidelines produced within the project (Project Result 3). The aim of the guidelines is to provide a toolkit with all the necessary resources to offer full support to those who want to implement STEM policies.



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Definition of objectives and content

Establishing a summer camp in the STEM field necessitates meticulous planning. Primarily, it is imperative to articulate the camp's objectives and content, laying the groundwork for the creation of a captivating and intellectually stimulating program tailored to the participants' needs. This initial step not only provides a strategic direction for the camp but also enables the formulation of activities that not only meet educational objectives but also cultivate an enjoyable and enriching learning environment.

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The objectives of the summer camp must be clearly defined, realistic, and tailored to meet the unique needs of the participating students. This involves articulating a goal, such as providing participants with a deeper understanding of the fundamental principles of science, technology, engineering, and mathematics, while also offering them opportunities to apply these principles in a practical context.
It is paramount to consider the age and specific needs of the participants when shaping the objectives of the summer camp. Since different age groups have distinct needs, customizing the program to address their specific requirements is essential.

Once the objectives are established, the next crucial step is to develop compelling and engaging content for the summer camp. This could involve creating projects such as a smart greenhouse, designing a Bluetooth speaker, or developing a video game.

Furthermore, involving students in defining the content of the summer camp is pivotal. Soliciting their opinions and needs not only contributes to a more engaging and stimulating program but also enhances their overall experience

This phase encompasses an analysis of the local context, focusing on the labor market dynamics, the supply-demand misalignment, territorial inclinations, and existing educational pathways.

The definition of specific objectives referring to the general objectives of this type of activity is foreseen:

- Approach to STEM disciplines
- Orientation to future educational and professional choices
- Countering gender stereotypes
- Promotion of technical-scientific culture in the territory

The STEM camp's foundation could derive from elements such as the region's inherent strengths or the existing disparities in supply and demand.

Consider assessing the potential interest and utility in reaching out to companies that might be inclined to collaborate in executing the camp.

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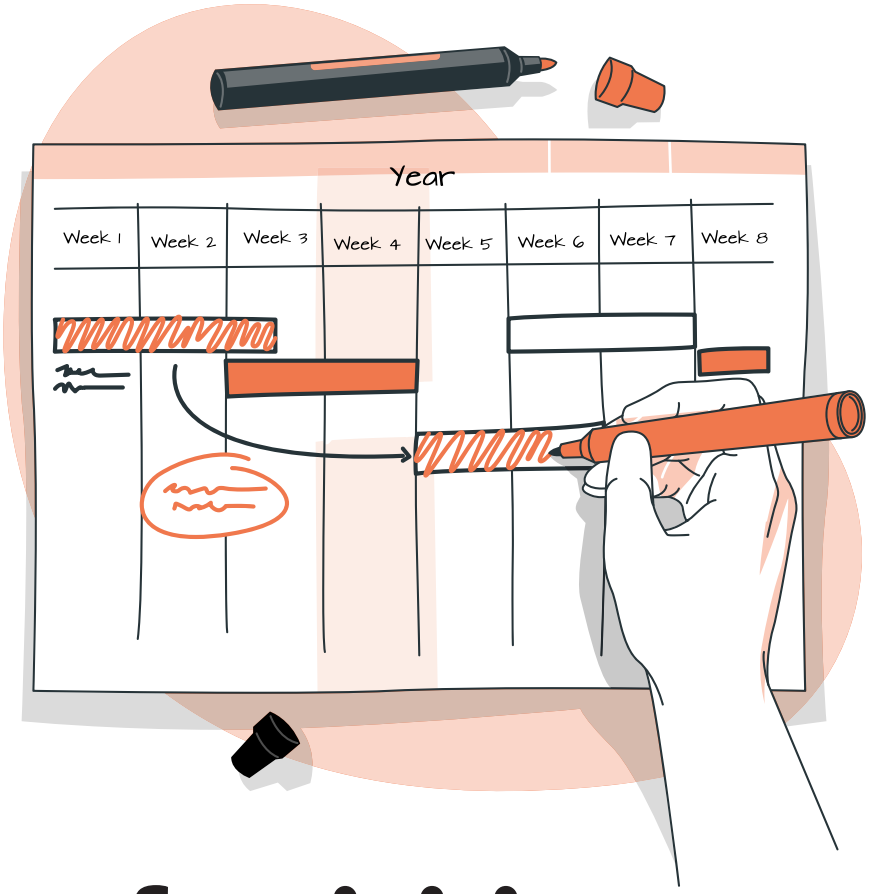

Articulation of activities
(priorities and sequencing)

The strategic planning of activities and the meticulous definition of their sequence constitute pivotal elements for the success of any project, with particular relevance to a STEM camp. To effectively realize the summer camp's objectives, it becomes imperative to disaggregate these goals into specific activities and precisely determine the chronological order in which these activities will unfold.

Dissecting the objectives into specific activities not only contributes to the overall organizational structure of the camp but also facilitates the assessment of whether the stipulated objectives are practically achievable. For instance, if the camp aims to deepen participants' understanding of fundamental STEM principles, corresponding activities might involve theoretical lectures, hands-on workshops, and visits to local STEM-focused businesses and industries.

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Similarly, if the overarching goal is to challenge gender stereotypes in STEM disciplines, integrating testimonials from accomplished female professionals within the STEM field could be a noteworthy activity.

Following the definition of activities, prioritization becomes paramount to ensure the seamless execution of preparatory tasks and prevent any knowledge gaps that may impede the overall flow of the camp. For instance, if the camp's objective involves creating an intelligent greenhouse, one of the initial steps would be to determine the plant selection based on their characteristics, water, and light requirements. Additionally, establishing a well-thought-out sequence of activities is essential; while some tasks can occur concurrently, others must be meticulously scheduled in sequence.

Given the immersive nature of a camp where students are engaged throughout the day over several days, it is crucial to incorporate moments of leisure and communal interactions among students. Striking a balance is key to prevent students from feeling overwhelmed by the workload. Despite the camp's primary function as an orientation platform, it must equally serve as a conducive environment where students can peacefully immerse themselves in the activities, ensuring that the learning and orientation experience is enjoyable and uplifting rather than demoralizing.

In summary, this phase of the camp involves strategic planning without delving into intricate details, thereby creating a comprehensive overview of the training aspects. At the end of this phase it is necessary to have an adequate response to several answers, including:

- How many days does the camp last?
- How many hours per day are foreseen?
- What time of year is the camp held?
- Is it a residential camp or another type of camp?

Furthermore, it is essential to determine the allocation of camp time between soft skills and technical skills, considering the specific objectives outlined in the preceding section. This includes defining the balance between theoretical and practical aspects of the camp, with a conscious effort to prioritize hands-on, experiential activities to actively engage participants. Establishing a framework in this manner not only ensures a harmonious blend of theoretical and practical elements but also facilitates the coherent presentation of the camp's activities to potential participants.

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Definition of the characteristics of the group

Before implementing a STEM summer camp, it is important to define the characteristics of the group that will be involved:

- What is the age of the participants?
- What is the knowledge and skill level of the participants?
- What is the educational background of the participants of the STEM summer camp?
- What is the level of interest of the participants in STEM subjects?
- What is the group size of the STEM summer camp participants?
- What is the composition of the group of STEM summer camp participants? For example: only girls? Boys and girls? Students of different ages or students with special educational needs? Understanding the composition of the group can help tailor the learning experience to meet the specific needs of the group.

The number of participants must take into account a balanced ratio of participants to teachers (cf. also detailed design and resources).

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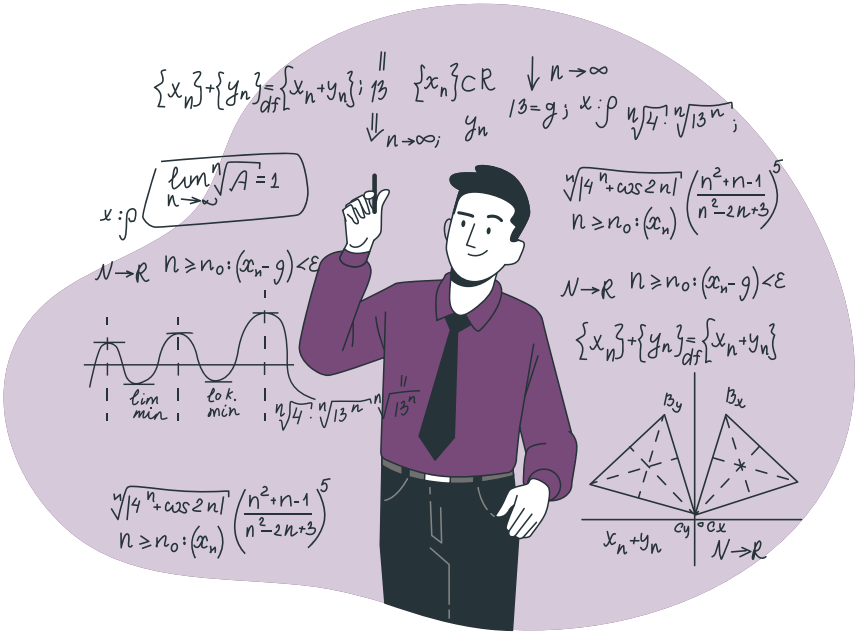
Analysis teaching methods



Ensuring the utilization of effective and engaging teaching methodologies is pivotal for the success of a STEM summer camp. Crafting an analysis of which methodologies to employ necessitates a thorough assessment of participants, encompassing their needs, as well as their current levels of knowledge and skills. The following questions can guide this analytical process:

- What are the objectives of the camp and how can they be achieved through the use of different teaching methodologies?
- What are the needs of the camp participants?
- Which teaching methodologies are best suited to their knowledge and skill level?
- How can digital technologies be used to enhance their learning experience?

The analysis of potential teaching methodologies necessitates a meticulous assessment of participants, considering their needs, knowledge levels, and skills. Often, the optimal approach involves a strategic blend of different methodologies for the successful implementation of the camp. Here are examples of methodologies that could be employed:

- Lectures: The best known and most widely used teaching methodology involving a teacher or expert delivering information or concepts in a systematic and structured way to the participants of the activity. Lectures can be used to provide a basic overview of a topic or to go into specific notions in greater depth.

- Experience-Based Learning Activities: Students engage in hands-on, practical activities that necessitate the application of knowledge and skills from various disciplines. This type of work promotes experiential learning and the acquisition of

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practical skills through direct experience.

- Pair or Group Work: Students collaborate in small groups or pairs to accomplish specific tasks or projects. This collaborative setting encourages teamwork, idea exchange, and mutual support among peers.
- Project-based learning: This methodology involves summer camp participants working on specific projects during the summer camp. Participants can work in groups or individually to develop a project that is in line with the objectives of the summer camp. This methodology encourages active learning and participation by the participants.
- Challenge-Based Design: This method presents complex problems that demand the integration of multiple disciplines to find solutions for students. Working on such challenges fosters the development of critical thinking and problem-solving skills.
- Gaming: The use of educational games is an educational methodology that can be used to engage summer camp participants and support learning. Educational games can be developed to teach specific concepts, such as programming or physics, or to develop soft skills, such as problem solving or collaboration.
- Video-based teaching methods: The use of educational videos is a teaching methodology that can be used to provide information and demonstrations on a specific topic. Videos can be used to provide a general overview of a topic or to delve into specific notions.
- Quiz-based learning activities: The use of quizzes and tests can be an effective teaching methodology to test the learning of summer camp participants. Quizzes can be used as a review activity or as a tool to assess participants' learning.
- Interdisciplinary Teamwork: In this approach, students from diverse disciplines collaborate on a STEM project, leveraging their specific knowledge and skills to contribute to the team's success. This method encourages the seamless integration of various disciplines and cultivates essential collaboration skills.
- Peer Teaching: In this method, students take on the role of educators, teaching their peers about a particular topic while integrating knowledge from different disciplines.

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Peer teaching enhances collaboration and empowers students to develop teaching and learning skills among themselves.

To these can be added other methodologies that can, for example, also make use of innovative and technological tools: the use of virtual reality (VR) and augmented reality (AR) provides the participants with an immersive and engaging experience, allowing them to interact with virtual objects and environments in a realistic way (e.g., for an astronomy summer camp, VR can be used to explore the solar system). It is also possible to base learning on research, during which students can carry out small research activities, learning how to collect, analyze and read data, understanding concepts better through direct experience.

Another methodology is simulation-based learning: a specific environment or situation can be reproduced to teach participants how to respond and act in certain situations. A final example is gamification-based learning, which involves the use of playful elements combined with scores, levels and rewards, to motivate participants and make learning more engaging and stimulating.

Selecting the most suitable methodology involves strategically identifying and combining teaching approaches to align with the objectives of the summer camp and the unique needs of participants. Moreover, continual evaluation of the effectiveness of these methodologies during the summer camp is essential, allowing for necessary adjustments to enhance the overall learning experience for participants.

In order to define the most suitable methodologies, certain elements are necessary:

1. What are the aims of the STEM camp, as a teaching methodology might be more suitable to achieve the aim;
2. The needs of the participants: the teaching methodology chosen should be adapted to the needs of the participants, such as knowledge and skill level, individual preferences and educational needs;
3. The availability of resources, such as budget, personnel involved and equipment;
4. The innovation of methodology and the involvement of participants.

It is indispensable to start evaluating potential training models that can effectively support both the orientation process and the approach to STEM subjects.

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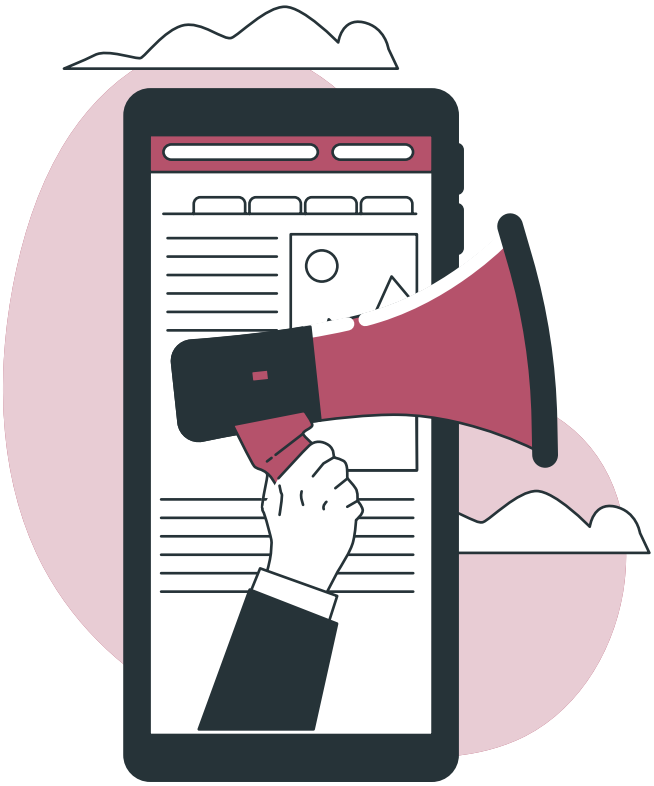

Promotion of the initiative

It is necessary to define to which participants the activity will be open:

- Are they already pre-defined students/young people?
- Is it necessary to build an ad hoc communication and promotion?
- Is it necessary to involve external educational institutions that need time and tools to collect registrations?

If promotion is needed, it's crucial to identify the right channels and assess available economic resources for the upcoming stages. Additionally, consider the time required for information dissemination and generating interest in the initiative.

Whether it's direct promotion or targeting participants from external organizations, it should emphasize:

- Objectives of the activity;
- The outline programme;
- Coverage of expenses and possible contributions from participants;

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- The application procedures;
- The selection criteria and any possible exclusion criteria.

Promotion, an essential step in gathering support, can be carried out through various channels:

- Advertising through social media proves to be an effective marketing strategy for reaching a broad spectrum of students. Platforms such as Facebook, Instagram, X, TikTok, and LinkedIn can serve as avenues to promote the STEM summer camp. Establishing dedicated events or pages for the initiative and sharing visual content, such as photos and videos of past activities, enhances visibility.
- Sending emails to students as well as teachers and parents is another impactful promotional approach. Drawing from the project partners' experience, it's noted that emails often benefit from follow-up efforts, whether through subsequent phone calls or additional emails.
- Collaboration with schools emerges as a valuable partnership for promoting the activity. Schools can disseminate information to students' families via emails or letters, post announcements on their websites, or share details during classroom sessions.
- Furthermore, organizing promotional events in collaboration with schools, libraries, or other public entities can generate interest and spur enrollment.

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Participants selection

The participant selection phase is pivotal in the successful execution of the activity. Choosing the right participants can determine whether the learning experience is stimulating and engaging, meeting participants' expectations. This chapter delves into the criteria governing participant selection, the selection process itself, and additional considerations that warrant attention. Throughout the application collection and subsequent selection phases, it is imperative to transparently articulate the criteria guiding participation in the camp. Clarity in communication regarding selection criteria is essential for fostering transparency in the entire process.

Defining the criteria for participant selection stands as a crucial step in the overall process. The criteria should align with the objectives of the activities. For instance, if the goal of the STEM summer camp is to foster students' interest in science, it becomes pertinent to consider selecting students who may lack exposure to science subjects within their school curriculum. On the other

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hand, if the aim is to provide an advanced learning experience in a specific STEM field, the selection process may prioritize participants with advanced knowledge and skills in that field.

In the practical experience of the STEM for Future project, it's noteworthy that school merit is not necessarily the predominant factor for participation in a STEM-oriented program. Informal occasions often reveal that learners facing challenges in traditional academic settings exhibit heightened proactivity and a keen willingness to learn and collaborate with others. This insight underscores the importance of considering a broader spectrum of attributes beyond conventional academic achievements during the selection process.
From the standpoint of managing this aspect of camp implementation, three additional elements must be considered:

- The internal resources that will be involved
- The most appropriate selection process
- The tools needed for the selection process

There are various methods for participant selection. Whether the process is internal or external to one's own context, it's crucial to evaluate different selection tools and determine their functionality. Several tools are available, and here are a few examples:

- Admission questions, with questions to gather information about their previous experience in STEM, their motivation to participate and their learning objectives (for example:"have you ever participated in other STEM camps?", "why would you like to attend the camp?", "what do you expect from participating in the camp?").

- STEM knowledge and skills tests, to assess applicants' competences in a given STEM field. These tests can be administered online or in-person. They are particularly useful if one wants to be sure that participants already have some prior knowledge. They prove to be non-functional in the case of guidance activities for people with no experience in the STEM field.

- Interviews, used to assess the motivation and interest of candidates, can be conducted in person or via video conference.

- Evaluation of the personal characteristics and aptitudes of the participants, using for example questionnaires to evaluate interests, motivation and soft skills (for example the 16 personalities test: https://www.16personalities.com/)

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- Group assessments to assess candidates' social and cooperation skills already at the selection stage. These exercises may include team building activities, problem solving exercises or role-playing. Uninteresting in the case of guidance activities that want to involve young students, who are probably unaccustomed to working in groups but who may benefit from the STEM field to improve these skills as well.

A special emphasis on motivation is crucial, particularly when the activity is scheduled long after the selection process. In such cases, it becomes important to organize face-to-face or online meetings during the period between selection and the commencement of the camp. These interactions serve the dual purpose of supporting and sustaining the motivation of the participants while also maintaining regular communication with them. This proactive approach helps cultivate a sense of engagement and ensures that participants remain connected and enthusiastic about the upcoming camp experience.

Once the participants have been selected, they will receive an email/call to ask them to sign the STEM Summer Camp Participation Agreement, which must include the terms and conditions of participation in the summer camp. It should also include information on activities, obligations of the participant and the organization/school, informed consent and logistics, as well as contact details.

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Detailed design and resources

Detailed planning is a crucial step that becomes feasible once a clear understanding of the learning objectives, activities, and required resources for the camp is established. The initially defined objectives, adhering to the SMART criteria (Specific, Measurable, Achievable, Relevant, and Defined), should be further broken down into engaging and stimulating activities. These activities may encompass hands-on projects, presentations, team collaborations, visits to companies, and workshops.

At this point it is necessary to go into detail about each activity on the time required, the resources and equipment, the personnel involved and the expected results. This must be accompanied by an evaluation method for each activity: although this may seem redundant compared to the general evaluation of the entire activity, it allows the progress and actual achievement of the objectives to be monitored in a timely way. It also makes it possible to evaluate possible corrective actions in the event of criticalities.

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The detailed planning also makes it possible to verify what was assessed in the planning phase, including the actual sequentiality and logicality of the activity, which thus follows a coherent order, enabling all participants to actually achieve the expected and necessary competences. In this phase, it is also possible to prepare any teaching materials that will support the students during the activity but also before or in the self-study moments, which could help to fix any themes that have been addressed during the activity.

Equally important alongside STEM skills are soft and transversal skills. It is essential to plan activities in advance to ensure that these skills become integral elements in creating a calm and welcoming learning environment for all participants. Incorporating activities that foster communication, collaboration, critical thinking, creativity, adaptability, and other essential soft skills will contribute to a holistic and enriching educational experience. This proactive approach ensures that participants not only acquire technical knowledge but also develop the interpersonal and problem-solving skills vital for success in diverse fields.

A further point in the detailed planning, which is extremely important but also interesting in order for the activity to have a real impact in the future, is the involvement of companies, moving from sponsorship to collaborations. Going into detail, in the case of sponsorship, companies can be involved with the provision of material resources such as equipment, tools, teaching materials or other. In turn, the company can gain visibility and recognition as a sponsor of the camp. For collaborations, companies can be involved by asking to give testimonials or guided tours in their realities. In this case, companies act as inspirers for the young students, enabling them to better understand the labour market and the STEM sector. For example, if one of the objectives of the camp is to counteract the gender gap in STEM fields, female professionals in STEM disciplines could share their experiences and act as role models. Another interesting way to involve companies could be mentoring during the stem camp. Involving them as mentors/experts in the sector means accompanying the participants in their daily work, providing them with advice and support.

The involvement of companies is a very interesting element, but not always easy to implement. Being able to establish a collaboration plan with them (not necessarily formal) would be an important result, and an advantage for the camp participants and for the company itself. It is necessary to be transparent and clearly communicate the benefits of the event for both of them. The company can

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also be involved to launch a challenge/project for participants to develop throughout the camp (in the case of a challenged/project based activity). In this case, it should be borne in mind that not all companies are clear about how their activity can be translated into an orientation course for young students. Teachers and trainers will therefore have to intervene to help them identify interesting points that can be carried over into the camp.

At this point, it is possible to proceed with the definition of the detailed calendar: the calendar should include the start and end dates of the STEM summer camp, daily activities, breaks, etc. From experience within the STEM for future project, it is interesting to provide such a calendar to the participants, almost like a working agenda. On the one hand, this allows greater transparency of everything that will be done, but it also fosters a sense of responsibility on the part of the participants. They are not passively involved in the activities, but they know the structure in detail, they can actively identify ways of meeting deadlines knowing that not all days can be devoted entirely to the project they are working on, etc.

A further step to be taken at this point in the organization of the activity is the identification of resources. This term refers to everything that can support the camp's activities and objectives. They can therefore be of different types:

- Human resources, trainers, teachers, mentors, tutors, etc;
- Material resources, e.g. computers, 3D printers, robotics, laboratory equipment, teaching materials, etc.;
- Financial resources, i.e. what budget allows for covering direct/indirect and internal/external costs of the camp.

When the resource element is included towards the end of the planning phase, close to the start of the activity, it is important that the planned activities, identified objectives, etc. actually fit the available resource capacities. For instance, it would be too costly in organizational terms to design a camp for augmented reality if one does not have the tools or trainers available to deliver this activity.

One particular note concerns the ratio between the number of participants and the number of teachers/trainers involved. The number depends on several factors, such as the planned activities and the level of support required by the activities. It would be appropriate to have 1 teacher for

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every 10 participants, approximately, but this also depends on the type of specific needs that each participant requires (e.g. special educational needs, learning difficulties, etc.).

Another element to take into account is the possible use of tools or the complexity of the proposed programmes, which increase the number of teachers/trainers per participant.

A final note for human resources: not only is it important to involve in the activities STEM teachers (who have in-depth knowledge of the subject and teaching skills), but also non-STEM ones. On the one hand, this allows a multidisciplinary approach, integrating the more technical scientific subjects with the social sciences, the arts and the humanities, making the application plan of technical concepts and skills more creative. Interdisciplinarity can also foster and encourage the creation of more innovative solutions and develop new ideas, which are often not conceivable and possible in a purely technical and scientific approach.

Non-STEM teachers, moreover, can put the focus on many other aspects, related more to transversal and soft skills, such as communication, problem solving, public speaking, problem solving within teams. Such an approach can also foster diversity and inclusion: the presence of non-STEM teachers can help to promote a different model of learning, thus encouraging access to more technical and scientific subjects for all participants, regardless of their background. It will be possible to show the possible interactions between STEM and non-STEM worlds, facilitating the understanding of how technical skills are now pervasive in all sectors and not necessarily linked to a distant and different world.

It is part of the detailed design phase to define the services related to any residential camp. Key services are accommodation, meals, security, possible evening activities and transport to the training site. All of this information must be included in the agreement that will be provided and signed by the participants when they are selected for the programme, discussed in the previous section.

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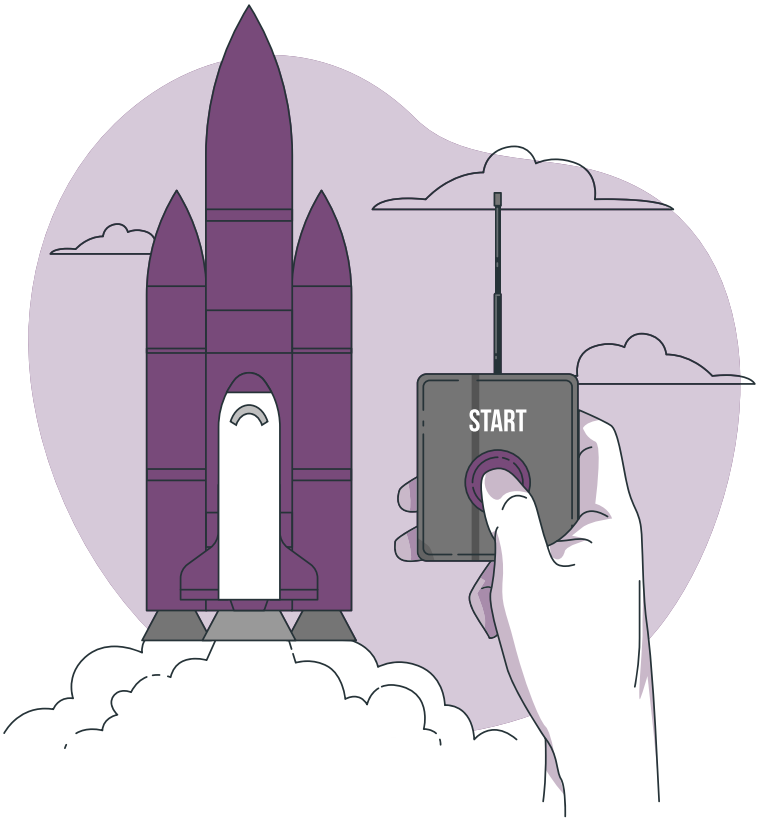
Introduction of the camp and start of activities



The introduction to the STEM camp and the commencement of activities represent crucial moments that significantly influence the success of the program and participant satisfaction. Upon arriving at the camp location, students should be warmly greeted by the program staff and receive a formal welcome. Establishing a welcoming and trusting atmosphere during this stage is crucial, fostering an environment that puts participants at ease and readies them for learning and collaboration.

To familiarize students with the campsite and planned activities, organizing a staff-led orientation activity is advisable. This activity serves to acquaint participants with the camp's facilities and resources while facilitating interaction with fellow participants. By providing this orientation, the aim is to create a sense of comfort and camaraderie among the participants, setting a positive tone for the entire STEM camp experience.

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To enhance students' understanding of the week-long camp's schedule, it is beneficial to provide them with a structured agenda outlining daily tasks. Moreover, offering a personalized calendar that allows customization based on group activities and individual roles within the group can be advantageous. This approach not only aids in time management but also empowers participants to actively engage with and take ownership of their learning experience throughout the STEM camp. Providing students with an activity overview and a detailed agenda serves several purposes:

- Enhanced Comprehension: it deepens their understanding of planned activities, objectives, and the skills they will acquire throughout the STEM summer camp. This comprehension enables adequate preparation, ensuring active and effective participation.
- Encouraging Involvement: it promotes student involvement in activity planning, fostering a sense of belonging and motivation. Understanding how activities are organized and how their tasks align with those of their peers makes students more responsible and committed to the project.
- Identifying Preferences and Needs: a detailed agenda facilitates the identification of students' preferences and needs. If specific activities capture their interest, more time can be allocated, or the agenda can be adjusted accordingly. This responsiveness to students' input elevates their engagement and participation in the overall camp experience.

Equally important is providing information about the materials and equipment required for planned activities. This empowers students to prepare adequately and bring along necessary items if needed. Additionally, it's crucial to elucidate how materials and equipment will be managed, outlining safety measures and ensuring resource availability throughout the activities. This transparency not only facilitates a smoother execution of planned tasks but also contributes to a safe and organized learning environment for all participants.

In addition, it is imperative to outline the rules and behavioral expectations that students are required to adhere to during the activities. These rules may include guidelines for punctuality, safety protocols, responsible use of materials, cooperation with fellow participants, among others. Furthermore, it is essential to explain the consequences for rule violations, emphasizing the commitment to maintaining the well-being and respect of all participants.

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Finally, disseminating essential organizational information to participants, including contact details of the organizers, is crucial. This ensures seamless communication and coordination throughout the STEM camp, fostering a supportive and well-informed environment for both students and organizers.

Following the orientation activity, the detailed exploration of activities commences, starting with the icebreaker activity. This initial engagement is designed to help students break the ice, fostering an atmosphere of cooperation and trust. It provides an opportunity for participants to acquaint themselves with others, interact, and develop greater group cohesion.
With the introduction to the camp and the initiation of activities, the STEM camp officially begins, marking the start of a collaborative and enriching learning experience for all participants.

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Assessments tools, quality assessment questionnaires and certificates of attendance

Evaluation serves as a pivotal element in measuring effectiveness and ensuring the continuous improvement of activities. It offers an opportunity to monitor and enhance the program by addressing several key points:

- Evaluation of STEM Skills Enhancement: vital for measuring effectiveness, this evaluation should be based on specific, measurable objectives aligned with the program's goals. Assessment tools, such as tests, practical activities, and observations, should be chosen according to the specific activities of the camp. Enables participating students and teachers to assess their knowledge and skills in STEM fields, monitoring progress throughout the program.

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- Evaluation of Satisfaction: based on clear and specific criteria, satisfaction evaluation tools should allow students and teachers to express their opinions on the STEM program, its organization, and the quality of activities. Provides valuable feedback for program improvement.
- Evaluation of Impact: conducted at the end of the activity, this evaluation focuses on the participants' orientation towards post-diploma training and occupational pathways. Utilizes an additional questionnaire administered six months after the camp to investigate participants' orientation towards professional and/or educational choices, along with any changes and motivations. Provides insights into the long-term impact of the program on participants' decisions and aspirations. By addressing these facets, the evaluation process becomes a comprehensive tool for gauging effectiveness, enhancing participant satisfaction, and understanding the lasting impact of the STEM camp

The Project Result 2 document can provide a model for the design and implementation of an assessment tool for STEM camps including some technical tips to submit the tool to the participants. This tool focuses mainly on the evaluation of changes in STEM perception and self-efficacy, of satisfaction and of the impact rather than evaluating the increase in STEM skills. These aspects are more difficult to quantify and not usually considered in the assessment of STEM camps, but extremely important in terms of participants' future orientation and effectiveness of the activities.

Absolutely, evaluation is a fundamental component in the process of continuous improvement. It should be viewed as an opportunity to identify both strengths and weaknesses of the activity, allowing for the development of strategies and subsequent actions. Regular evaluation during the camp is essential to ensure timely actions can be taken and corrective measures activated promptly. This proactive approach enables organizers to address challenges as they arise, optimize the learning experience for participants, and enhance the overall effectiveness of the STEM camp. Certifying attendance at STEM camps serves multiple crucial purposes. It enables an assessment of students' engagement and active involvement throughout the activity, offering a tangible record of their acquired skills and knowledge. These certifications can be valuable additions to students' CVs, underscoring their participation in extracurricular activities and showcasing specific skills.

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Such credentials can be particularly advantageous during job searches or when applying for educational or training programs.

Moreover, certification of attendance has the potential to cultivate student loyalty and promote the activity itself. When students receive recognition through certification, they often feel valued and motivated to engage in similar activities in the future. This fosters a network of loyal and satisfied participants, contributing to the growth and sustainability of such programs.

Several types of certifications are available, each serving distinct purposes:

- Certificates: These verify an individual's participation in the activity and can include details on the activities undertaken, skills acquired, and the level of their involvement.
- Qualification Certificates: These attest to an individual's proficiency in a specific area and are awarded only if the individual has demonstrated a certain level of knowledge or competence.
- Open Badges: These digital images symbolize the acquisition of specific competencies and can be shared on social media or integrated into online CVs. Open badges are typically awarded upon the mastery of a particular skill, enabling individuals to showcase their abilities in digital environments.

The primary distinction among certificates, qualification certificates, and open badges lies in the type of information conveyed and the specificity of the competencies they validate. Certificates confirm participation, qualification certificates endorse competence in a particular domain, while open badges signify the acquisition of specific skills, readily shareable in online settings.

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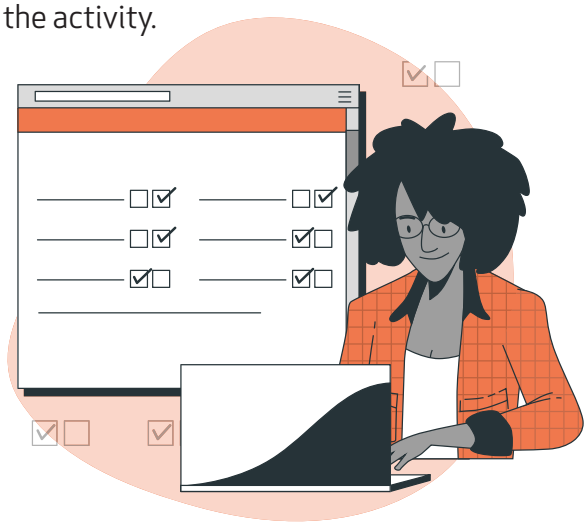
Conclusions and recommendations

During the implementation of the European Project STEM for future, the implementation of the camps followed the model presented in this document. As mentioned at the beginning of the document, the implementation has to take into account several characteristics: not always the delivery methods of one country can be shared by other countries, just as often some ideas proposed within a national camp turn out to be interesting good practices to be included in future camps.

With a view to improvement and peer review, a series of verification activities were defined and a real peer review was structured. From what emerged, we report some suggestions and elements to be taken into consideration when implementing the activity.



Peer review

Following the steps indicated in the format, observation grids were created which were filled in by the teachers and trainers involved during the implementation of the camps. For each step in the format, they were asked to indicate the time period, who was involved, the results obtained and any critical issues that arose during implementation.

The experts' peer review was based on the observation grids already compiled: for each project partner country, an expert from outside the project was identified. Once the completed evaluation grids had been read out, each expert gave his or her own assessment of the findings, indicating the strengths and weaknesses of each camp.

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The summary of the main points of the peer review include the following conclusions:

1. Considering the level of satisfaction and learning that can be gathered from the analyses made during the camp, a very high level of satisfaction is measured and the usefulness of having a wide variety of activities within the same camp.
2. Favorite activities: most of the students agreed that theoretical activities were the least appreciated and that they much preferred practical, playful, fun and stimulating activities. The experts report this as a point of attention when defining the detailed planning and training methods to be used.
3. A visit to STEM companies would be interesting.
4. It is important to put into practice the skills and learning acquired during the summer camp.
5. Among activities, the most popular are the ones including robotics, AI and programming.
6. Team working is a must, and pre-established groups and changing roles is also something positively valued.
7. As for soft skills, Summer Camps have contributed to improve a number of soft skills such as problem-solving, teamwork, communication, creativity, patience, leadership, etc.
8. Participants would like to take part in any way they can in the International Summer Camp design.
9. Although not that popular among students, experts have expressed the importance of including math and science activities.
10. Some interesting proposals by experts include the development of an application to solve a real problem and increase the students soft skills, the use of challenge based learning methodologies, the possibility of holding programming and robotics championships, etc.

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Interview with Ambassadors

The project included the creation of Ambassadors for each partner country. The role of the Ambassador is to tell and present the project to their peers, promoting activities that they have experienced directly. They have been involved in the animation of the project's social pages and in events in the classrooms of their schools and educational realities. The ambassadors themselves were also involved in a peer review process about the activities in their camps. Here are the highlights and the main lessons learnt from them from the interviews conducted.

1. Level of satisfaction and learning: in general, participants are highly satisfied: they consider that they have grown in competency and skills, they also have been creative and they have implemented a project by themselves (self-learning). The usefulness and variety of the activities is also pointed out. Moreover they had fun and at the same time they have reached awareness about the importance of STEM.

2. Aspects of the Summer Camps to be improved or to focus on: Ambassadors suggest to include more detailed previous information about the Camp contents for a higher participants' motivation. Also, the theoretical activities were less popular for them, so this was taken into account for the International Camp. Programming and robotics activities were much preferred to Science ones.

3. If students could organize the International Summer Camp they…
    a. Would always try to have a balance between hard work and fun.
    b. Would include the four STEM fields in a practical and user-friendly way.

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c. Would use the Challenge Based Learning methodology.
d. Would focus on Technology (robotics and programming activities).
e. Would always work in groups (pre-established groups and changing roles is also something positively valued).

4. After the camps they…
   a. Have a better understanding of STEM education, its importance, applicability and usefulness for their employability.
   b. Have understood the connections and interactions between STEM fields to develop a final product.

5. As for soft skills…
   a. The most used in the Summer Camps were team working, creativity, decision-making, problem-solving, leadership, communication and organizational skills.
   b. Ambassadors recognise their importance in their professional future, in all job positions (someone mentions that they are as important as hard skills in the workplace, and they increase workers' competence).
   c. In general, Summer Camps have contributed to improve a number of soft skills such as problem-solving, teamwork, communication, creativity, patience, leadership, etc.

6. When asked if acquisition/lack of STEM education will affect their professional life, they unanimously confirm it, therefore having STEM skills will increase their employability while not having them will make them less competitive for the labour market.

7. In relation to gender issues, there are different opinions. Some of them think that there is still a big gender gap, affecting different fields, and there are still prejudices and a lot of work to be done, not only in the workplace, while others are not that concerned about this topic. There are comments pointing out that they hope that this issue will hopefully play a smaller role in the future, and how unfair it is to be valued by your gender and not by your skills.

8. When asked about how to make STEM education more attractive, some interesting remarks are:

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a. STEM education should be considered not only for smart/nerd students, but for everybody.
b. Nobody should be afraid of STEM subjects.
c. If STEM education was real life problem based, then more students could see its practical benefits.
d. It could be very helpful to show how these areas impact the future, using examples of how they affect people's daily lives.
e. It is crucial to raise awareness through dissemination in celebrities' social media and didactic presentations in public schools.

9. Some final remarks: according to the Italian Ambassadors, one way to involve the participants could be to engage them in the planning of the International Summer Camp. Being included already in the planning phase could in fact increase motivation to participate. One way to get them included could be to use brainstorming.

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Practical Ideas

DEFINITION OF OBJECTIVES AND CONTENT

Our objective was to furnish participants with a comprehensive grasp of the fundamental principles encompassing science, technology, engineering, and mathematics. Furthermore, we aimed to facilitate their exploration of latent talents and passions within these disciplines, guiding them toward a more profound self-discovery.

Given that we were thinking about creating an international summer camp that would involve people with very different backgrounds, languages and ages, we needed simple and engaging activities to allow them to collaborate together while learning about STEM and their practical application. Another goal to consider was the contrast to gender gap in STEM, given the severe underrepresentation of female students and workers in these disciplines.

Our idea was to make them design a bluetooth speaker starting from recycled materials, for many reasons. First of all, this kind of project can be related to different STEM subjects (electronics,

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technology, mathematics…). Secondly, choosing to let them create something that has to do with music can be interesting for young people and allow us to involve them from day one. Furthermore, this activity can facilitate the development of different soft skills (creativity, team work, problem solving, communication....), which is another goal of our camp. Finally, the theme of recycling and the circular economy, a very current and crucial topic, directly involves our daily lives: therefore, it is important that the theme of the green transition accompanies this type of activity.

ARTICULATION OF ACTIVITIES

(PRIORITIES AND SEQUENCING)

Given that the idea was to create a camp for people with different STEM levels, we decided to anticipate the practical activities with a theoretical explanation of the STEM subjects involved. For example, before they could start designing their own speaker, we needed to explain to them how to use a design software. We decided to proceed in this way with all the other technical subjects.

Furthermore, to create the bluetooth speaker, priorities were established among the technical activities, starting from knowing which components they need to assemble in order to then be able to take measurements and match their project to the electronic components.

Because the idea was to involve participants that didn't know each other, we decided to include different moments dedicated to soft skills, with the aim of creating a better collaboration between each other. Another reason to include these activities was that the development of non-technical skills is as important as the development of technical ones to find and maintain a job in a labour market that requires to continuously update your technical skills. For example, we decided to start the first day with icebreaking activities that on one hand could develop soft skills and, on the other, could let them know each other.

We decided to dedicate 5 days for the activities (6 hours per day) within the same week, in order to allow participants to completely develop their products. The camp was held in July, where students were not engaged in school activities. Our evaluation was also made with respect to the actual financing resources available, but it is also possible to propose a longer activity, always considering the actual resources.

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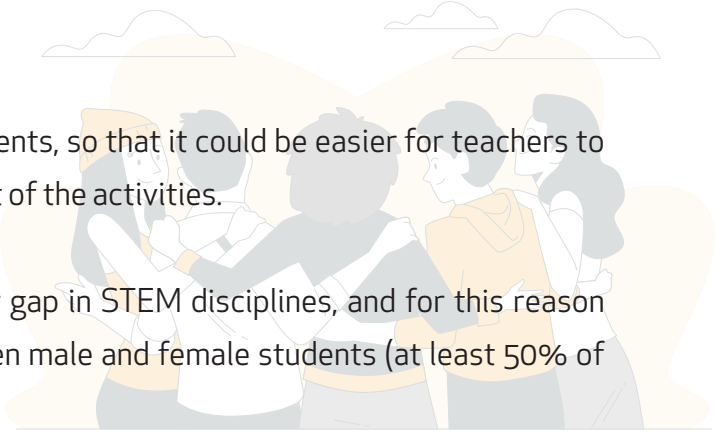
DEFINITION OF THE CHARACTERISTICS OF THE GROUP

Considering that the goal was to develop an international summer camp, one of the characteristics to take into account is the English level of participants, that should at least allow them to communicate properly.

We especially promoted the camp among students without a previous technological background in order to let them discover the possibilities that STEM disciplines offer them in everyday life and in different application fields.



The group size shouldn't include more than 25 students, so that it could be easier for teachers to follow and help every group during the development of the activities.

One of the camp's goals was to reduce the gender gap in STEM disciplines, and for this reason we decided to have an appropriate balance between male and female students (at least 50% of female participants).

ANALYSIS TEACHING METHODS

To deal with the STEM component of the camp, we decided to use different methodologies:

1. Challenge based learning: we decided to provide them with a challenge (the creation of a bluetooth speaker), with a practical approach, because this encourages participants to grapple with problems relevant to their own reality and it also makes them more engaged in the activities.

2. Team work approach: we decided to divide participants in small groups because this methodology allows the development of many soft skills (communication, decision making, coordination, problem solving...) within the small team context.

3. Lectures: as mentioned in the previous paragraph, some theoretical explanations were needed to let participants understand the basis of STEM disciplines; nevertheless, this methodology didn't represent the main part of the camp.

In order to develop soft skills, in addition to the team working approach, we also used for the icebreaking activity the quiz-based methodology, to increase engagement among participants.

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Another methodology used to reach this goal and to make them reflect upon the gender gap in STEM disciplines was a role playing activity, which through the assumption of different roles can facilitate the development of different soft skills such as critical thinking, creativity and lateral thinking.

PROMOTION OF THE INITIATIVE

Every country promoted the initiative in different ways:

1. Estonia, Spain and Portugal decided to involve students that had attended previous national camps. However, in the case of Spain, it was also necessary to find two new students due to the last minute resignation of two participants. The new students were chosen on the basis of a good level of English, motivation and enthusiasm for the camp.
2. Italy, in addition to the involvement of the ambassadors appointed in the national camp, had the necessity to promote the initiative with an ad hoc communication among local schools, collaborating with teachers to spread the voice and to diffuse the poster related to the project. Interested students could register for the camp via a registration link on the flyer.

PARTICIPANTS SELECTION

Every country selected participants in different ways:

1. Italy didn't have the need to make a selection as it was able to include all the participants registered via the flyer used to promote the camp.
2. In Spain, as it has been mentioned above, the main idea was to count on the participants of the previous year's summer camp. As the number of participants exceeded the number of places available for the international camp, the students were chosen based on their interest and level of English. Finally, due to the resignation of several people, two new students were selected. This was done through the teachers involved in the project, who informed their students about the activity, its relevance and objectives. The two new participants were finally selected because they had a better level of English and the approach to STEM disciplines was more useful to them.
3. In Estonia, most of participants (4) had attended local STEM camp during previous summer and they had shown motivation for international camp. Two new team

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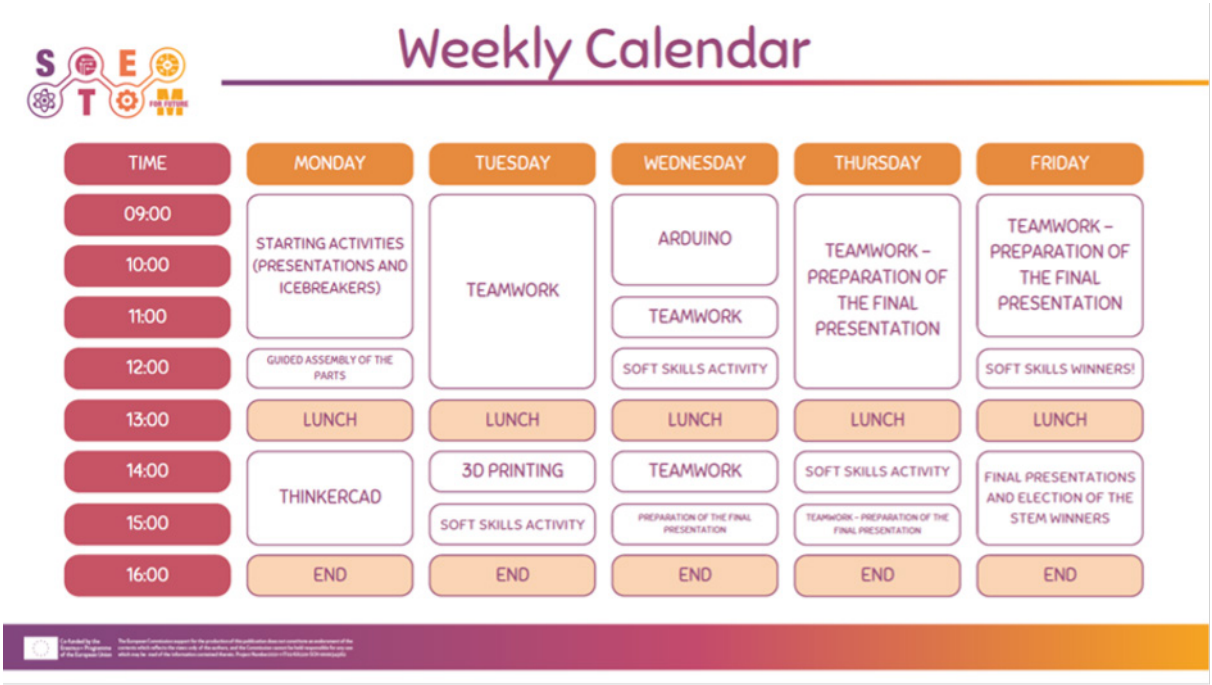
members had shown activity and interest in STEM projects and events at school during schoolyear.

4. In Portugal, it has been selected students from secondary level education that were interested and available to go abroad and participate in the project, that were able to understand and speak in English language and that have shown dedication and critical thinking in the studies.

The final group of participants involved 25 young people aged between 17 and 30, of whom 15 were female and 10 were male.

DETAILED DESIGN AND RESOURCES



The calendar has been defined in detail, specifying for each activity the time required, the resources and equipment, the personnel involved and the expected results.

Taking into account the resources needed, that's what it's been identified:

- Human resources (trainers, teachers and tutors): 5 STEM teachers were involved, each with their own specialization, who could follow the participants during the development of STEM activities. The ratio of participants to teachers was 5:1, in order to follow every group (composed by 5 participants) for every need. Moreover,

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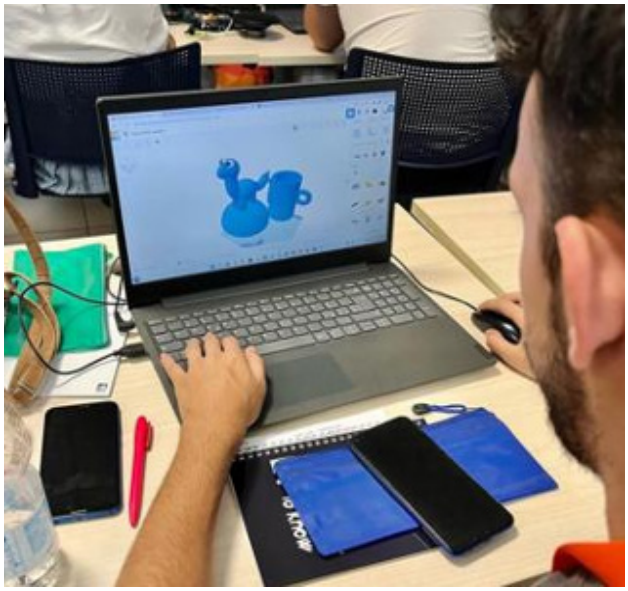
2 non-technical teachers were involved to deal with the soft skills activities, which represented more or less the 20% of the camp.

- Material resources: PCs were provided to all participants for the entire duration of the camp; other materials were used to realize the bluetooth speakers, some of which were purchased (Bluetooth Amplifier, Speakers, AC/DC Adapter) while others were already available to the teachers (3D printers, soldering iron kits, multimeter, cutting tools, etc.).

INTRODUCTION OF THE CAMP AND START OF ACTIVITIES

The first day students were welcomed by the programme staff and the camp programme, objectives, rules of participation, etc. were presented. To create a welcoming and trusting atmosphere and to help familiarize students with the camp site and the activities planned, icebreaking activities have been organized.



ASSESSMENTS TOOL, QUALITY ASSESSMENT QUESTIONNAIRES AND CERTIFICATES OF ATTENDANCE

A few days before and after the camp, a questionnaire was administered to the participants to evaluate multiple aspects and how they changed after the camp experience:

- Background Information

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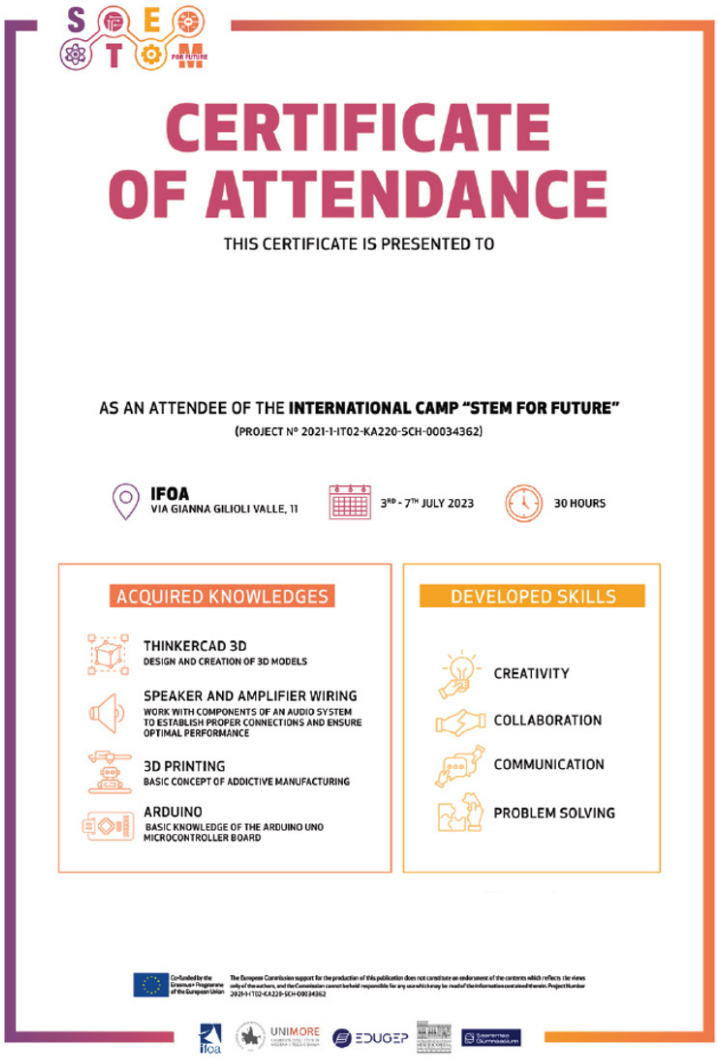
- Computer Science Perception
- Future Choices
- Gender Stereotypes
- Satisfaction

For further details on the test structure, it's possible to consult project result 2 - "Assessment tool", in which all the information on the content of the assessment tool are included.

Certificates of attendance were delivered at the end of the camp to attest the students' participation. Here you can find an example of the certificates used at the end of our international camp


CERTIFICATE OF ATTENDANCE

THIS CERTIFICATE IS PRESENTED TO

AS AN ATTENDEE OF THE **INTERNATIONAL CAMP "STEM FOR FUTURE"**

(PROJECT N° 2021-1-IT02-KA220-SCH-00034362)

IFOA
VIA GIANNA GILIOLI VALLE, 11

3RD - 7TH JULY 2023

30 HOURS

ACQUIRED KNOWLEDGES

- THINKERCAD 3D — DESIGN AND CREATION OF 3D MODELS
- SPEAKER AND AMPLIFIER WIRING — WORK WITH COMPONENTS OF AN AUDIO SYSTEM TO ESTABLISH PROPER CONNECTIONS AND ENSURE OPTIMAL PERFORMANCE
- 3D PRINTING — BASIC CONCEPT OF ADDICTIVE MANUFACTURING
- ARDUINO — BASIC KNOWLEDGE OF THE ARDUINO UNO MICROCONTROLLER BOARD

DEVELOPED SKILLS

- CREATIVITY
- COLLABORATION
- COMMUNICATION
- PROBLEM SOLVING

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