PROJECT RESULT 2

STEM SKILLS ASSESSMENT TOOL

FOR FUTURE

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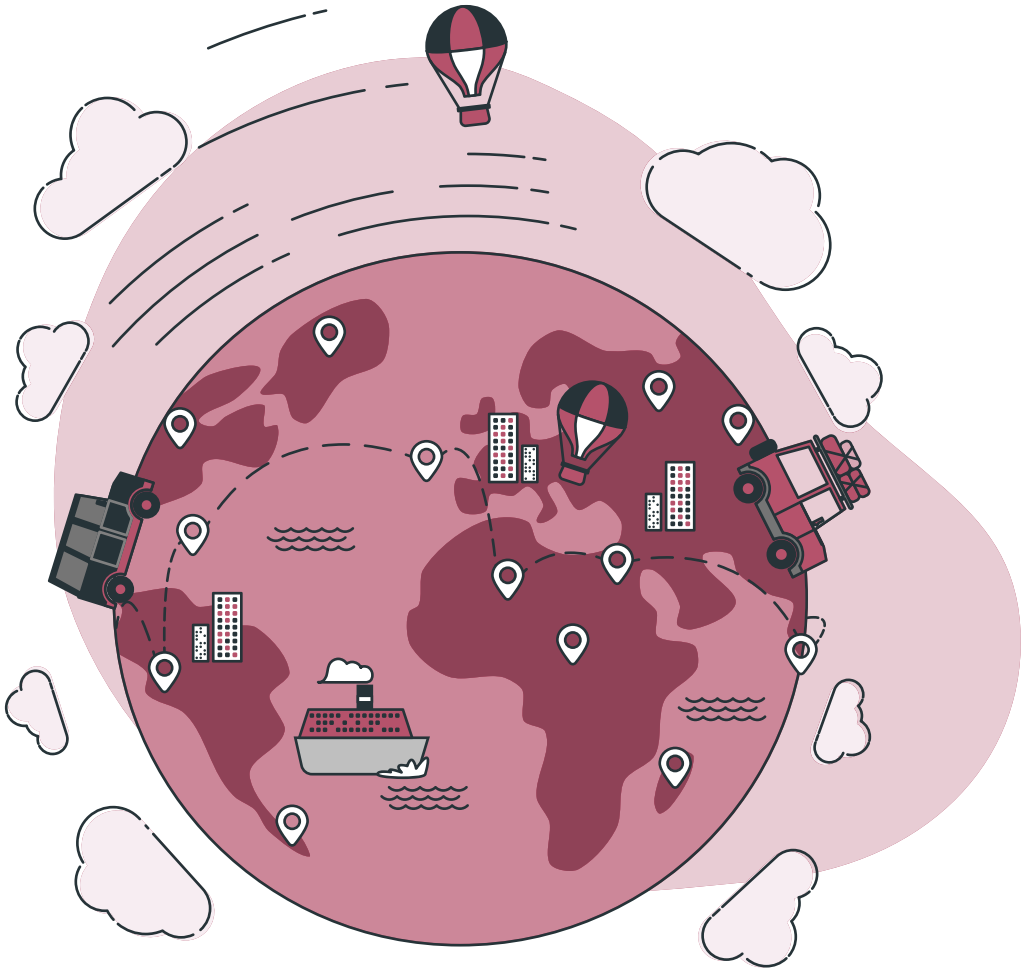

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Introduction

Developing relevant STEM and digital skills is vital for Europe to fully embrace the benefits of the unprecedented social and technological revolution we are currently witnessing on a global scale and remain competitive in the global market. The digital age has revolutionized and transformed the dynamics of our everyday lives and caused radical changes in most industries and productive sectors. New technological innovations, changes in production modes, digitalization, and globalization have laid the foundations for the emergence of the Fourth Industrial Revolution, a concept coined by Klaus Schwab, the founder of the World Economic Forum (Schwab, 2015).

The current scenario moves past outdated industrial and post-industrial logic to focus on the need to train new generations in the scientific and technical knowledge that is the basis of many of today's careers and, especially, tomorrow's. Thus, STEM (an acronym for Science, Technology, Engineering, and Mathematics) career profiles are the most sought-after today and are intended to meet the needs of future society. The European Commission, indeed, figures show that two-fifths of the EU workforce have little or no digital skills, and by 2030 there will be 50 million open vacancies worldwide for positions requiring STEM skills. Furthermore, a study by the Organization for Economic Cooperation and Development (OECD) predicts that many of the jobs in highest demand today will disappear by 2030 and be replaced by jobs directly or indirectly related to the STEM fields (a very likely prediction if we consider that in 2013 there were 1.2 million STEM jobs to be filled and demand for STEM professionals today has more than doubled).

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The 2022 report of the European Commission on the DESI index (Digital Economy and Society Index) highlights how many European countries are still quite behind in terms of the global level of digitization. A particularly significant element concerns the component of the DESI index related to the human capital, i.e. digital skills, including not only basic skills owned by the population but also the percentage of young people trained or graduated in the ICT (Information and Communications Technology) field. In example, concerning data regarding at least basic digital content creation skills, 2 of the 4 countries involved in this project have a score that is below the European average, with Italy in the forth to last place among the 28 EU countries, and Portugal in 21-th position. On the other hand, Estonia and Spain present scores above the European average, with a ranking corresponding to 10-th and 14-nd positions, respectively. According to the Commission, possible solutions to improve the current situation include initiatives to enable young people to acquire the required skills and competencies while also developing non-formal methods for their teaching, such as STEM camps and extracurricular activities.

Recent statistics about European and worldwide conditions indicate that women's presence in STEM and ICT professions and related university programs has not significantly improved in the last decade, and women are still severely under-represented in these fields (Eurostat Statistics, 2017-2019). Both literature and real data show that gender differences with respect to interests, sense of belonging, self-confidence and engagement towards STEM and computer science are already in place at an early age (Spieler et al., 2020). Reaching a complete understanding of the reasons for this gender gap is a complex task, but (at least some of) the main motivations appear to be related to social and cultural related issues, such as gender stereotypes in the computer science field (Master, 2021). Stereotypes, in general, influence people and produce misrepresentations: computer science is typically associated with the masculine role, but stereotype misconceptions may also regard physical appearance, personality type and digital ability projected onto young females, negatively influencing their academic decisions and career choices (Berg, 2018). The European Commission suggests that the gender gap should be addressed by a set of policies that include breaking gender stereotypes by means of awareness-raising campaigns and concrete actions (European Commission, 2018), such as earlier interventions in students' lives, including extracurricular activities and training (Davaki, 2018).

The STEM for future project aimed at developing among young people an increased knowledge and culture about new professional opportunities enabled by technology through a set of learning

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opportunities targeted at enhancing their STEM skills, by non-traditional learning methods such as STEM camps. Specifically, project objectives are: a) to develop and test a method for empowering STEM skills of young people next to completing upper secondary school and for guiding them towards their subsequent study or career choices; b) to develop an assessment methodology allowing the measurement of impact on participants; c) to promote the exchange of practices and results, by devising guidelines for transferring and replicating proposed activities in other EU countries.

It is worth noting that in the last years, many public and private institutions have undertaken initiatives and actions with the goal of attracting young people and especially girls towards STEM disciplines through activities such as summer camps and dedicated laboratories where the participants are exposed to hands-on experiences about coding and or doing projects. However, these activities typically lack a proper assessment regarding the resulting impacts and effects on the participants. Indeed, the main focus of such programs is usually more on the implementation of STEM activities and team-based projects, and occasionally on measuring the overall satisfaction of participants rather than on a comprehensive and specifically designed evaluation of the obtained impacts.

The STEM for future project aimed at designing and developing an assessment tool to evaluate the impact of the activities carried out during the STEM camps on the participants and on their future choices in terms of studies and careers. In the design of the assessment tool, we chose not to focus on the direct measurement of the increase in STEM 'hard' skills, because such evaluation is so strictly depending on the specific activity carried out during the camps that hinders the possibility to create a generic tool for this purpose. On the other hand, given the main objective of the project, it is of utmost importance to measure the impacts of the STEM camps on participants' future choices in terms of study and careers, to evaluate the effectiveness of the implemented activities on attracting young people towards STEM fields. To this purpose, the proposed assessment tool is focused on measuring the main elements that, both in the scientific literature and in the project partners' experience, are likely to affect participants' future choices, such as perception and understanding of the main concept and of the importance of STEM education, satisfaction for realized projects, and experience of team working. Moreover, the tool allows teachers to collect information on aspects of the participants' background that are likely to be correlated with a future choice in STEM fields, such as the presence of a parent working or having interests in a STEM

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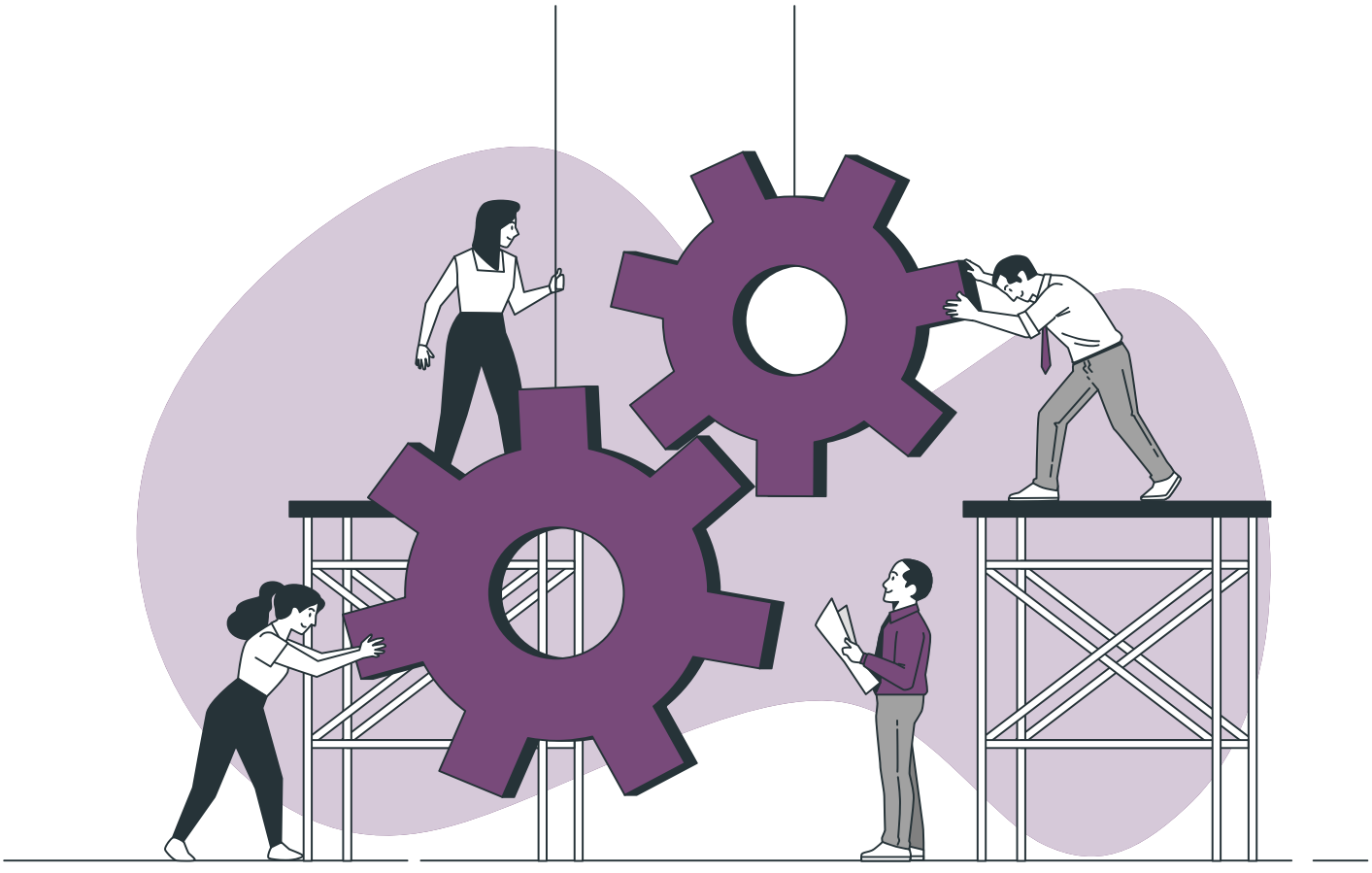
discipline, or the habit of playing video or computer games. Finally, the use of the assessment tool gives information about the presence of gender conscious or unconscious biases.

This document presents 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. The document includes a background and state of the art analysis that helped us to support the main design choices for the developed tool. Furthermore, a section is dedicated to defining the objectives of the assessment and presenting the main structure of the tool with a description of its components. The final Appendix reports the assessment tool actually used during the project for the evaluation of the national STEM camps.

The following points are intended to guide trainers and practitioners willing to develop STEM camps for young people towards the design and implementation of a proper assessment tool to measure the real impact of the developed activities and to eventually refine the actions taken.



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Background and state of the art analysis

In this section we summarize the activity of background and state of the art analysis, whose results were exploited to provide useful inputs to the assessment tool design phase.

Many STEM summer camps for high school students have been carried out in the last decade (Faenza et al., 2021). Still, these initiatives are usually not supported by proper evaluation tools allowing researchers and practitioners to investigate the eventual benefit of the camp initiatives on participants' future choices: the main aim of eventual surveys submitted after summer camps or extracurricular activities is usually limited to the evaluation of the participants' overall satisfaction.

In some cases, the used survey structure and methodology are provided as an appendix. An example is the case of (Danoff M., 2017), which provides the methodology used to assess gender barriers towards Computer Science at Harvard. However, the study focuses on college students and the survey is tailored to the Harvard faculty context. In other cases, the study's main aim is to give suggestions and guidelines for STEM summer camps without providing adequate information about the assessment phase (Davis et al., 2013; Mohr-Schroeder et al., 2014). On the other hand, a structured, specifically designed survey solution is necessary to investigate other meaningful

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aspects and the real impacts of the camps.
Some studies specifically focus on the analysis of gender gaps in STEM and on the identification of the main factors that impact girls' choices in terms of future studies and careers. The survey by (Spieler et al., 2020) included analyses of 28 peer-reviewed articles on that topic, highlighting in particular how different factors can impact the decision to choose a degree course in STEM. They also investigate the self-perception of participants about their capabilities in ICT and the similarities and dissimilarities between their identity and the perceived identity of an ICT expert (Lewis, Anderson & Yasuhara, 2011). Moreover, correlations between video game playing and attitude toward ICT are also studied: (Davies et al., 2014) shows a correlation between students who do not play video games and students who describe their computer skills as poor or do not spend much time on technological devices. Finally, teachers' and parents' influence on participants' aspirations are analyzed in (Wong & Kemp, 2018).

An in-depth study investigates the social and cultural stereotypes in ICT, negative impressions experienced during ICT classes and influences that may prevent participants' interest in this field (Spieler et al., 2020). The study revisioned 28 peer-reviewed articles on the themes and was very helpful in orienting our choices about the survey design. As a result, we decided to include questions about family support and the ability to identify themself with ICT experts.

The proposed assessment tool also includes the use of an Implicit Association Test (IAT). The IAT test has recently been widely used to assess mental associations (e.g., associations with race, gender, and more) and to predict judgment and behavior (Greenwald et al., 2009). In particular, it is considered a valid instrument to measure the implicit association of STEM-related and non-STEM-related words with female and male names (Farrell et al., 2017; Smeding et al., 2012). The main principle behind the IAT test is that self-exploration is subject to introspective limits. The test measures the differential association of 2 target concepts with an attribute: the two concepts appear in a 2-choice task (e.g., flower vs insect names) and the attributes in a 2nd task (e.g., pleasant vs unpleasant words for an evaluation attribute). When instructions oblige highly associated categories (e.g., flower + pleasant) to share a response key, performance is faster than when less associated categories (e.g., insect + pleasant) share a key. This performance difference implicitly measures the different associations of the two concepts with the attribute (Greenwald et al., 1998). As stated by the Harvard online platform Project Implicit (https://implicit.harvard.edu), the IAT measures the strength of associations between concepts (e.g., black people, gay people)

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and evaluations (e.g., good, bad) or stereotypes (e.g., athletic, clumsy). The participant is asked to categorize terms displayed at the screen's center as quickly as possible. On the left and right of the screen, two or more categories in opposition to each other are shown (Figure 1). The main idea is that categorizing a term is more straightforward when closely related categories are displayed on the same side of the screen.

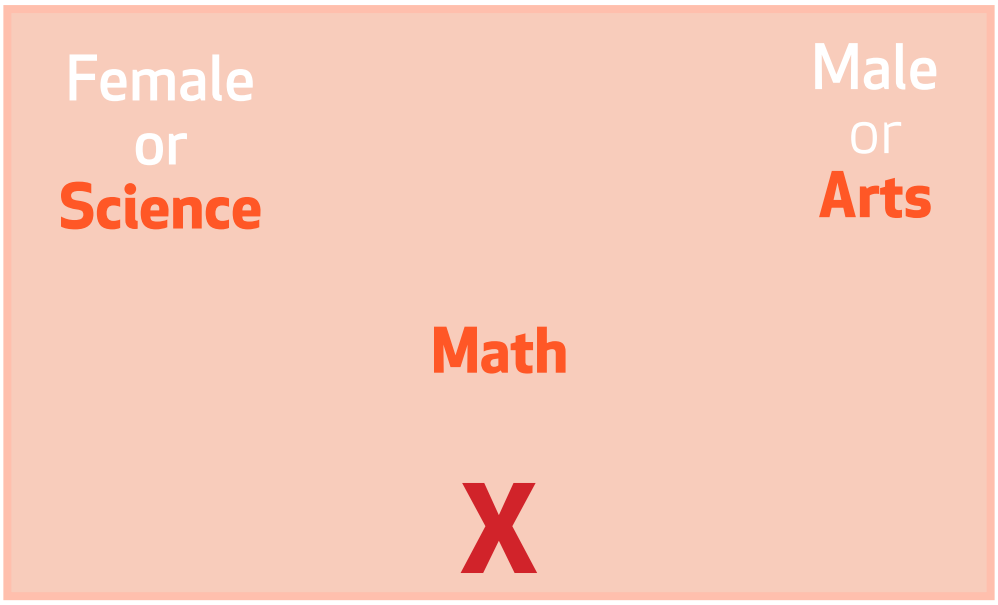

Figure 1: Screen of an IAT test being employed.

Including the IAT test led to the less obvious matter of choosing an instrument to operate it online. The LimeSurvey tool used in previous years did not allow the inclusion or the development of an IAT test. Hence, our choice was to migrate to a more complex platform, Qualtrics. The availability of an open repository, IATGEN (Carpenter et al.,2019), to develop an IAT test integrable inside Qualtrics' surveys led to this choice. IATGEN is an open-source tool written in R that can generate an IAT test as a survey element composed of HTML and Javascript; it also offers a suite of data analysis tools for processing the resulting data.

From the analysis of the state of the art and of the existing assessment tools, we can conclude that there are no instruments which can be directly reused or easily adapted to evaluate the impacts on participants of STEM camp activities. Our project aims to fill this gap by proposing an assessment tool that may be easily adopted by teachers willing to replicate a STEM camp experience.

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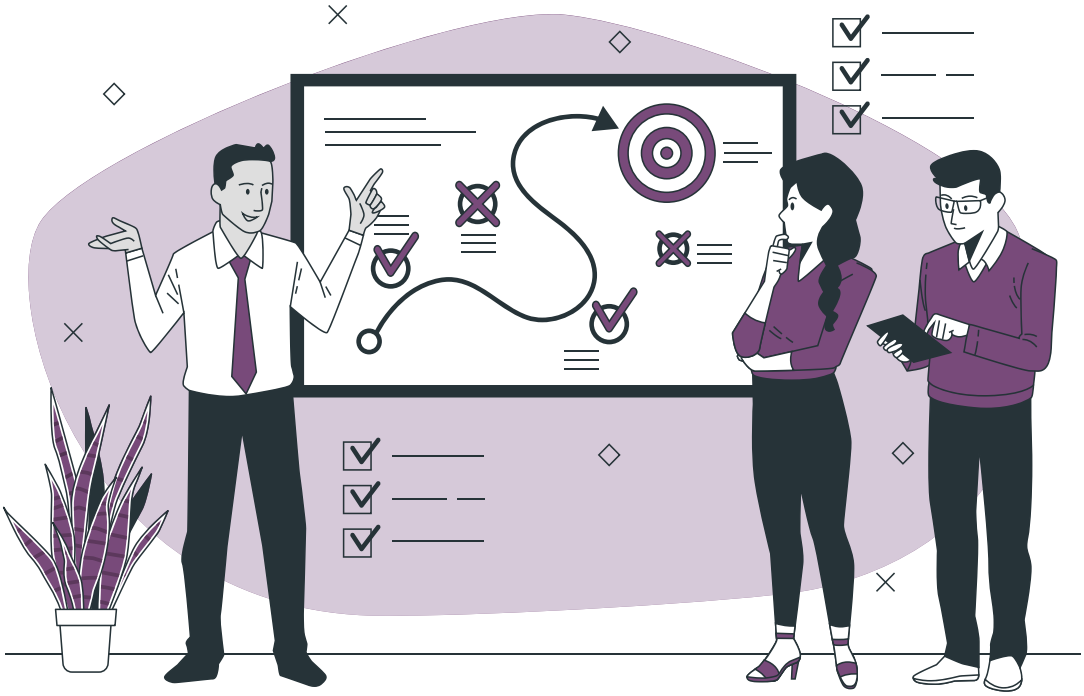

Objectives of assessment

Evaluation and assessment are fundamental elements for measuring the effectiveness of the implemented activities and for ensuring their continuous improvement. The assessment process may have several distinctive objectives, ranging from the measurement of the overall satisfaction to the evaluation of acquired competencies up to the short-term and long-term impacts on the participants.

- Assessment of STEM skills: the evaluation and the quantification of increase in skills related to the STEM disciplines involved in the camps (also called hard skills) can be done through several methods, such as specific practice tests, multiple choice questions, interviews or project discussions, usually well known to STEM teachers. The evaluation methods are strictly related to the kind of activities carried out. For example, during the STEM for Future project we privileged project based activities developed by teams of students: in this case, the evaluation of the hard skills improvement was carried out by the teachers observing the teams' participants during the development of the projects and evaluating their final presentation of the results. The strict dependency of the evaluation methods on the specific STEM

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activities involved in the camps hinder the possibility to generalize them to be included in a broad range assessment tool. For this reason, the assessment tool developed during this project focuses mainly on other aspects of the evaluation (listed below), that 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.

- Evaluation of changes in STEM perception and self-efficacy: crucial to measuring the effectiveness of the carried out activities, an assessment phase should be put in place to evaluate changes in STEM perception, which is usually confused and misleading among young high school students. 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. For these reasons, it is important to administer a questionnaire both at the start and at the end of the activity so as to effectively measure the changes in STEM perception and self-efficacy

- Evaluation of satisfaction, which must be based on clear and specific criteria. The proposed tool allows students and teachers to express their opinions on the STEM programme, on the organization and quality of the activities, and to provide useful feedback to improve the programme.

- Evaluation of impacts: at the end of the activity, it is recommended to evaluate the impacts on the orientation of the participants in the choice of the post-graduate training/work path. The proposed tool aims at evaluating short-term impacts, meant as changes in the participants orientation right after the activities, through the comparison of answers to the questionnaires submitted at the beginning and at the end of the camps. Moreover, the use of a further questionnaire is envisaged, which will be submitted to the participants 6 months after participation in the camp, to investigate long-term impacts on participants' orientation towards professional and/or training choices, as well as their changes and motivations.

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Assessment tool structure

In this section, we describe the general structure of the proposed assessment tool, specifically designed to evaluate the impact of extracurricular STEM camps on the participants. The evaluation tool comprises an online survey, which is submitted before and after the camp activities and includes two main parts: an initial IAT test and the main questionnaire. The questionnaire includes questions that can be categorized into five main categories: background information, computer science perception, future choices, gender stereotypes and camp satisfaction. The evaluation tool also includes a questionnaire to be submitted six months after the activities to evaluate the long-term impact on the orientation choices of the participants. Finally, the last part of the evaluation tool is dedicated to STEM camp teachers to capture their perceptions and points of view: this part includes semi-structured interviews and a satisfaction questionnaire.

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IAT TEST

As previously stated, we decided to include an IAT test in our surveys. The preparation stage of an IAT test requires selecting two categories of opposing concepts; then, words strongly related to each concept must be selected. In our case, we selected as target categories the couples "Science"-"Arts" and "Male"-"Female".

The idea was to test if there is a positive correlation between them, hence less time for categorizing words when the "Male" and the "Science" categories are on the same side of the screen. The objective was to employ the test before and after the camp to understand if camp activities could lead to a change in implicit associations.

More in detail, the chosen categories with stimuli were:

- Science: Maths, Physics, Chemistry, Statistics, Computer Science, Engineering, Mechanics, Electronics
- Arts: Art, History, Philosophy, Literature, Music, Teather, Language
- Male: Male, Man, He, Husband, Father, Uncle, Grandfather
- Female: Female, Woman, She, Wife, Mother, Aunt, Grandmother

An essential part of a successful IAT test is to use the mother language of the participants. In fact, for the use in the Stem For Future Erasmus+ project, a phase of translation in the mother tongue of each country participating in the initiative was undertaken.

Mindful of the time required for IAT test completion, more or less 15 minutes, we opted to forego testing additional associations, for example, an association between male/female and career/family. Other aspects were investigated using multiple-choice questions and free text answers.

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MAIN QUESTIONNAIRE

The main questionnaire consisted of two parts: one submitted at the beginning (before the camp questionnaire) and one at the end (after the camp questionnaire) of the camp activities. Some questions were repeated both before and after the camp in order to grasp the eventual change in the knowledge, perceptions and attitudes of participants after the experience. A list of question categories is presented below in order to better understand the proposed survey structure.

Personal background

The first category of questions is related to participants' background; since obviously there is no need to ask again at the end of the camp for the same, these pieces of information can also be collected at the moment of participant enrolment, provided that anonymity must be guaranteed. Questions of this category regard general information such as nationality, attending school address, place of birth and age but also more specific information:

- parents' employment;
- if and how parents are involved in or passionated with STEM or Computer Science;
- if the participant regularly plays video games and which one in particular;
- questions about their previous experience with STEM disciplines or coding.

Computer Science Perception

As a consequence of what we learned from the literature review, we decided to include questions in order to understand participants' beliefs about ICT professionals before and after the camp. In particular, we asked them to choose a few adjectives to describe an ICT professional and then a few adjectives to describe themself, with the aim of comparing the results before and after the camp and analyzing how those descriptions evolve. Also, before the camp, we asked what their idea was about the "ICT world" and how much they knew about it, while after the camp, we asked if their perception of the same has changed and, if so, how.

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Future choices

An essential section of our surveys is dedicated to participants' future choices. It is repeated before and after the camp initiative to understand better if the camp impacted participants' ideas. We ask participants whether they are willing to continue studying or to look for a job and which will be their field of study or occupation. Then, in the final survey, we ask if their idea has changed and why; in the initial survey, we ask them if they talked about the possible choices with parents or teachers and, eventually, what their opinion is.

Gender stereotypes

An entire section is dedicated to gender stereotypes; here, the aim is to understand if the participant believes or not if being a woman or having a family could pose an obstacle for the future choice or for having a career in STEM and ICT rather than in non-ICT fields. Also, these questions were submitted before and after the camp to understand if a major awareness about gender stereotypes in STEM study and work fields has arisen as a consequence of participation in the camp activities.

Participant Satisfaction

A final section submitted only at the after-camp survey analyses camp satisfaction in terms of general satisfaction and specific likings of single aspects of the camp, like activities employed, teamwork, teachers and more. Furthermore, we ask participants to highlight the best and worst parts of the experience and to suggest possible improvements.

QUESTIONNAIRE AFTER SIX MONTHS

The questionnaire that is submitted to the participants around six months after the actual participation in the STEM camp activities essentially focus on their intention about future choices in terms of studies and careers. We ask participants whether they are willing to continue studying or

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to look for a job and which will be their field of study or occupation. Then, we ask them again if their idea has changed and why as a consequence of the STEM camp participation. This questionnaire aims at capturing medium-long term impacts of the participants' future orientation. Furthermore, by comparing the results with those of the after-camp questionnaire, we evaluate if short-term impacts may differ from medium-long-term ones.

SEMI-STRUCTURED INTERVIEWS FOR STEM CAMP TEACHERS

Semi-structured interviews were designed with the main aim of capturing trainers' and teachers' perceptions and points of view about the format camp and the applied tools, including the assessment itself. The interviews were carried out after the end of the national STEM camps during the period October-November 2022, through online calls. At least two trainers for each country involved in the project consortium. It is worth noting that the format of a semi-structured interview has been chosen with respect to a simple questionnaire to allow the interviewers to go deeper into different details depending on the specific camp activities and on the results that emerged from the IAT and main questionnaire.

The semi-structured interviews include questions mainly focused on:

- Opinions on the process of submission of the assessment tool (strong and weak points, suggestions for change)
- Opinions on the methodology applied during the STEM camp (camp structure, activity

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planning, hard and soft skills foreseen)

- Opinions on the activities actually carried out during the camp, and their impact on the participants

Results from semi-structured interviews with teachers revealed several key takeaways. Italian teacher highlighted that the submission process of the evaluation tool and IAT test was generally smooth, but the time required for completion was a potential weakness, especially for slower students. Team organization and role-playing activities carried out during the camp had mixed reception, indicating a need for clearer instructions, and students' reliance on internet research highlighted a gap in basic STEM knowledge.

Despite these challenges, overall engagement and satisfaction were high, with a preference for teamwork and practical experiences. The Estonian perspective emphasized the participants' lack of preparation for STEM, highlighting the need for age-appropriate activities. The Spanish team faced challenges with the test's length and complexity, suggesting a need for pre-practice, while group planning and the use of STEM tools were positively received. The Portuguese team highlighted the importance of specific questions in the questionnaire, suggested gamification milestones, and stressed the need to address each STEM aspect individually. Overall, the importance of a smooth evaluation process, age-appropriate activities, and a balance between theory and practice emerged as common themes across the responses.

SATISFACTION QUESTIONNAIRE FOR TEACHERS

A final questionnaire to measure the satisfaction of the teachers and trainers of the STEM camps was designed and submitted after the end of the camp activities. This specific questionnaire is aimed at understanding the satisfaction of the teachers in their participation in the camp and about their own contributions to the activities.

Nearly all teachers participated in the survey, offering valuable insights into their experiences and perceptions during the camp.

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The questionnaire specifically encompasses Likert scale questions encompassing assessment of teaching enjoyment, integration into the staff team, satisfaction with the executed project, and perceptions of the inclusion of STEM and soft skills-related activities. These questions provide quantifiable information about various aspects of the camp. These structured questions facilitated the capture of responses through a standardized scale.

Additionally, open-ended questions delved into specific likes and dislikes about the overall experience, offering qualitative feedback. Furthermore, educators were invited to share their perspectives on potential improvements, generating valuable insights for refining future editions of the camp.

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Tool review

After the submission of questionnaires during the national camp, a substantial window of time was afforded for the analysis of the gathered data. This period allowed for a comprehensive examination of the responses, enabling a thorough understanding of participant perspectives and insights. The scrutiny of the questionnaire results paved the way for constructive refinements and enhancements. As a result, a final version of the questionnaire emerged: the refined instrument was used during the international camp iteration and is reported in the Appendix of this document.

The main modifications made to the questionnaire were threefold, all aimed at enhancing its effectiveness and efficiency. Firstly, redundant questions and those yielding non-significant results were eliminated. This strategic pruning not only streamlined the survey but also contributed to a reduction in the overall time required to compile the questionnaire without compromising the integrity of the data collected.

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Secondly, certain questions underwent modifications to better align with the research objectives, ensuring a more accurate exploration of the characteristics under investigation. This refinement aimed to enhance the precision and relevance of the gathered information. For instance, the initial version of the section dedicated to investigating participants' future choices after school delved into intricate details about various possible paths, dividing the inquiry into multiple questions. Guided by the results of our analysis, we opted for a more streamlined approach. The section was condensed into a single, targeted question: *"Please take a moment to think about your future. What would you like to do after high school?"* question (Appendix A, Surveys's questions number 11, 24, 42). Respondents were then provided with four distinct choices, encompassing enrollment in a STEM degree course, enrollment in a non-STEM degree course, enrollment in ITS, or entering the workforce in either a STEM or non-STEM-related field. This strategic consolidation not only simplified the survey but also ensured that all essential data for our analysis were captured.

A third modification involved the substitution of specific questions or entire groups of questions and the addition of new questions to address missing pieces of information. As an example, we transform a question included in the initial version of the questionnaire *"Have you ever played any video or computer games?"* into the more encompassing query *"Do you regularly play computer or console video games?"* (Appendix A, Before Camp Questionnaire, question number 6). This modification was implemented to shift the focus to the current frequency of gameplay. Another example is the addition of the question, *"Have you ever participated in a STEM promotion initiative or a STEM-focused short program before?"* (Appendix A, Before Camp Questionnaire, question number 17), which aimed to add important information for specific analytical cases, to identify participants with previous similar experiences. This process of modification, elimination, and substitution collectively resulted in the final version of the questionnaire that is documented in Appendix A.

A final consideration regarding the Implicit Association Test (IAT) is that its submission demands both time and specific technical supporting instrument, as detailed in the Technical Tips section. Given the constraints of our international initiative, characterized by a limited number of participants with significant heterogeneity (less than 30 and representing diverse countries), the submission effort may not yield statistically significant results, leading to the decision not to administer the IAT test during the international camp.

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Technical tips for implementation

Concerning technical tips, we introduced the possibility of tracing the response evolution. Since our surveys were submitted before and after the camp, some questions were repeated to trace eventual changes in the participants' perceptions. To this aim, we connect answers given by the same participant before and after the camp. Moreover, we wanted to connect some background data collected at the moment of the camp enrollment. The solution was to assign each participant a code to use during the questionnaire submission and then completely anonymise answers during the analysis phase. This allowed us, after the camp, to join answers from the same person and remove the code for anonymization.

Another technical tip is about the adoption of a structured survey system. In the early years of the initiative, tools like Google Forms were mainly employed; however, the solution needed more advanced features like, for example, branching and skip logic for questions, templates, invitations and reminders by email and session-based survey. These needs have led in recent years to the adoption of LimeSurvey, an open-source online survey tool that can also be installed on-premises.

Finally, including the IAT test in the questionnaire may result in technical difficulties. To address this, we opted to utilize the Qualtrics platform, which allows the integration of survey elements composed of HTML and JavaScript. For generating the appropriate code to be included in the survey, we used IATGEN, an open-source tool that generates IAT tests to be included in Qualtrics.

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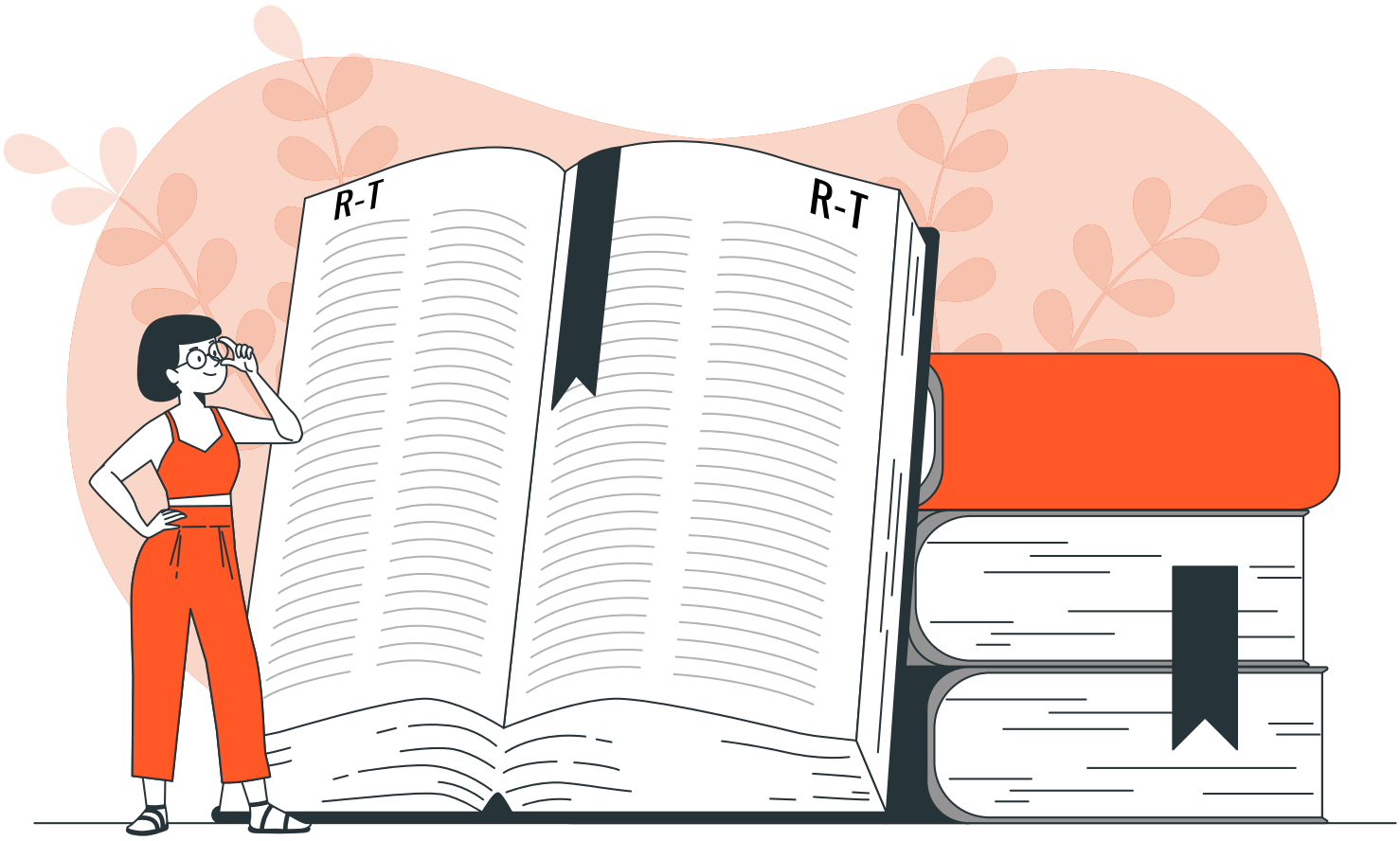

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Appendix

This appendix presents the actual assessment tool that has been used to evaluate the national STEM camps. This part of the document has the main objective to serve as a practical example of the implementation of an assessment tool for STEM camps that teachers and practitioners willing to replicate a similar activity with their students can exploit as a source of inspiration. The appendix is structured in subsections that report the different parts of the assessment tool.

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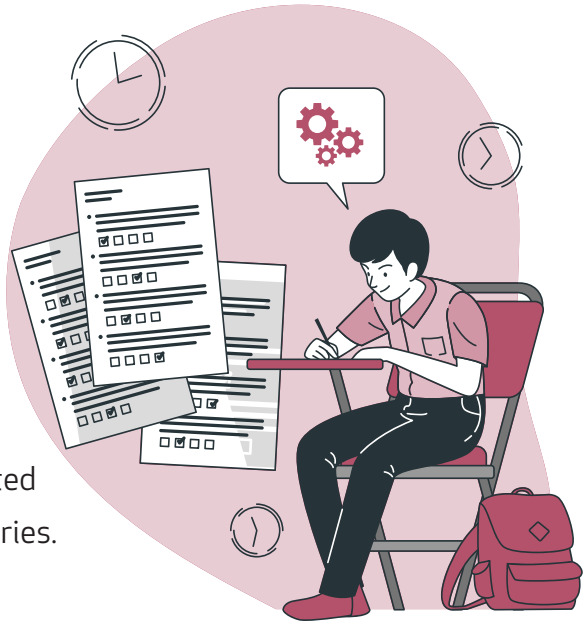

IAT TEST

The preparation stage of an IAT test involves selecting two opposing categories and choosing words related to each concept. For our test, we selected "Science"-"Arts" and "Male"-"Female" as target categories.

The chosen categories and stimuli were as follows:

Science: Maths, Physics, Chemistry, Statistics, Computer Science, Engineering, Mechanics, Electronics

Arts: Art, History, Philosophy, Literature, Music, Theatre, Language

Male: Male, Man, He, Husband, Father, Uncle, Grandfather

Female: Female, Woman, She, Wife, Mother, Aunt, Grandmother

IATGEN, an open source tools were then used to generate the code to be included into the survey platform, Qualtrics.

Before integrating it into Qualtrics, a round of translation was conducted. Since the IATGEN tool generates tests only in English, and using the participant's mother tongue is crucial for the test's success, we translated the generated test into all the relevant languages.

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BEFORE CAMP QUESTIONNAIRE

	Question	Question type	Answers	Question Category
1	Student code (a code should be associated and given to each student to be included in before and after surveys)			
2	Does your father work in the field of Science, Engineering/Technology, or Mathematics/Physics?	multiple choices	yes no other	Personal data
3	Does your mother work in the field of Science, Engineering/Technology, or Mathematics/Physics?	multiple choices	yes no other	Personal data
4	Does your father have a passion outside of his professional field related to STEM?	multiple choices	yes no other	STEM background
5	Does your mother have a passion outside of his professional field related to STEM?	multiple choices	yes no other	STEM background
6	Do you regularly play computer or console video games?	multiple choices	yes no other	STEM background
7	How many hours per week, on average, do you play computer/console video games?	interger number		STEM background
8	On a scale from 1 to 5, how much do you agree with the phrase: "I have a clear idea of what STEM education is"	scale	1 to 5	STEM perception
9	What characteristics and adjectives would you use to describe an expert in the STEM field?	open text		STEM perception
10	Which characteristic or adjectives have you in common with those you choose for an expert in the STEM field?	open text		STEM perception
11	Please take a moment to think about your future. What would you like to do after high school?	multiple choices	Enroll in a STEM degree course Enroll in a non-STEM degree course Enroll in ITS Enroll in workforce in a STEM related field Enroll in workforce in a non-STEM related field	Future interest
12	If you were to pursue a study or career path in a STEM-related field, what potential obstacles could you encounter?	open text		Future interest
13	On a scale of 1 (not at all) to 5 (absolutely), how much do you agree with the statement: "Being a woman can be an obstacle to work in a STEM-related field"?	scale	1 to 5	Gender stereotype
14	On a scale of 1 (not at all) to 5 (absolutely), how much do you agree with the statement: "Being a woman can be an obstacle to work in a non-STEM-related field"?	scale	1 to 5	Gender stereotype
15	On a scale of 1 (not at all) to 5 (absolutely), how much do you agree with the statement: "Having a family and children can be an obstacle to advancing in a career in a STEM-related field"?	scale	1 to 5	Gender stereotype
16	On a scale of 1 (not at all) to 5 (absolutely), how much do you agree with the statement: "Having a family and children can be an obstacle to advancing in a career in a non-STEM-related field"?	scale	1 to 5	Gender stereotype
17	Have you ever participated in a STEM promotion initiative or a STEM-focused short program before?	multiple choices	yes no other	STEM background
18	Describe what do you expect to find, know or learn from this experience	open text		Expectations

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AFTER CAMP QUESTIONNAIRE

	Question	Question type	Answers	Question Category
19	Student code (a code should be associated and given to each student to be included in before and after surveys)			
20	On a scale from 1 to 5, how much do you agree with the phrase: "Now I better understand what STEM education is and the fields connected to it."	scale	1 to 5	STEM perception
21	On a scale from 1 to 5, how much do you agree with the phrase: "I changed my mind about STEM after the camp"	scale	1 to 5	STEM perception
22	If you changed your mind about STEM after the camp, please explain how	open text		STEM perception
23	On a scale from 1 to 5, how much do you agree with the phrase: "I learned new things about STEM"	scale	1 to 5	STEM perception
24	Please take a moment to think about your future. What would you like to do after high school?	multiple choices	Enroll in a STEM degree course Enroll in a non-STEM degree course Enroll in ITS Enroll in workforce in a STEM related field Enroll in workforce in a non-STEM related field	Future interest
25	On a scale of 1 (not at all) to 5 (absolutely), how much do you agree with the statement: "Being a woman can be an obstacle to work in a STEM-related field"?	scale	1 to 5	Gender stereotype
26	On a scale of 1 (not at all) to 5 (absolutely), how much do you agree with the statement: "Being a woman can be an obstacle to work in a non-STEM-related field"?	scale	1 to 5	Gender stereotype
27	On a scale of 1 (not at all) to 5 (absolutely), how much do you agree with the statement: "Having a family and children can be an obstacle to advancing in a career in a STEM-related field"?	scale	1 to 5	Gender stereotype
28	On a scale of 1 (not at all) to 5 (absolutely), how much do you agree with the statement: "Having a family and children can be an obstacle to advancing in a career in a non-STEM-related field"?	scale	1 to 5	Gender stereotype
29	On a scale from 1 to 5, how important do you think the following aspects were during the camp experience: expressing my creativity	scale	1 to 5	Experience evaluation
30	On a scale from 1 to 5, how important do you think the following aspects were during the camp experience: being able to say "I made this"	scale	1 to 5	Experience evaluation
31	On a scale from 1 to 5, how important do you think the following aspects were during the camp experience: having fun	scale	1 to 5	Experience evaluation
32	On a scale from 1 to 5, how important do you think the following aspects were during the camp experience: working in groups	scale	1 to 5	Experience evaluation
33	On a scale from 1 to 5, how much did you like the "STEM for future" camp experience?	scale	1 to 5	Experience evaluation
34	If you were the "STEM for future" camp organizer what would you change? And why?	open text		Experience evaluation
35	What did you like the most?	open text		Experience evaluation
36	What did you like the least?	open text		Experience evaluation
37	What obstacles, if any, did you find during the experience?	open text		Experience evaluation
38	What did you learned from this experience?	open text		Experience evaluation
39	On a scale from 1 to 5, how satisfied are you with the project carried out during the camp?	scale	1 to 5	Experience evaluation
40	Which abilities did you developed during the camp experience?	open text		Experience evaluation
41	On a scale from 1 to 5, how much did you feel part of the groups?	scale	1 to 5	Experience evaluation

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AFTER 6 MONTHS QUESTIONNAIRE

	Question	Question type	Answers	Question Category
42	Please take a moment to think about your future. What would you like to do after high school?	multiple choices	Enroll in a STEM degree course Enroll in a non-STEM degree course Enroll in ITS Enroll in workforce in a STEM related field Enroll in workforce in a non-STEM related field	Future interest
43	On a scale from 1 to 5, how much do you agree with the phrase: "Attending the "STEM For Future" camp made me reconsider what I would like to do in my next future"	scale	1 to 5	
44	Please explain if and how attending the "STEM for Future" camp made you reconsider what you plan to do in your next future	open text		

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SEMI-STRUCTURED INTERVIEWS WITH TEACHERS

Questions:

1. Recall the moment of submission of the evaluation tool (questionnaire and IAT test) at the camp's start and end: what is your opinion on the tool and the submission process?
    - describe strengths and weaknesses
    - please explain what you would change
2. Think about the methodology applied during the STEM camp (es. camp structure, activity planning, hard and soft skills foreseen):
    - was it appropriate for the target group?
    - was it able to cover the spectrum of STEM disciplines?
    - describe strengths and weaknesses
    - please explain what you would change
3. Recall the activities actually carried out during the camp (how the activities were actually implemented):
    - did they meet the expectations?
    - describe instruments and tools utilized during the activities
    - describe unexpected issues and/or positive results
    - describe strengths and weaknesses
    - please explain what you would change
4. If you were to give a judgment on satisfaction and engagement from the point of view of the participants with respect to the activities, what would it be?

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SATISFACTION QUESTIONNAIRE FOR TEACHERS

1. How much did you like teaching during the "STEM for future" camp? (Likert scale)
2. How much did you feel like part of the staff team? (Likert scale)
3. How satisfied are you with the project carried out during the camp? (Likert scale)
4. How much do you agree with the phrase "STEM-related activities were satisfactorily included in the camp"? (Likert scale)
5. How much do you agree with the phrase "soft skills related activities were satisfactorily included in the camp"? (Likert scale)
6. About the overall experience, what did you like the most? And what did you like the least? (Open questions)
7. If you were to organize the same "STEM for future" camp, what would you change? And why? (open questions)

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FOR FUTURE

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