D5.1 EVALUATION INSTRUMENTS

Information about Tasks 5.1, 5.2 and 5.3

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1. INTRODUCTION

This document provides a comprehensive presentation of the instruments for the evaluation of the activities of the project, namely the interactive career talks, lighthouse activities, local fairs and open schooling activities. The document covers the methodology applied, the preliminary results obtained from piloting the instruments, the evaluation phases and timeline, and the detailed evaluation procedures that will be followed. Additionally, the document refers to the data analysis processes that will be followed for the analysis of the data that will be collected during the main phase oft he project, and concludes with the instruments.

The report is structured into four main sections:

- Methodology: This section describes the overall approach to the evaluation, including the design of the questionnaires, data collection methods and analysis for the piloting.
- Preliminary Results: This section presents the initial findings gathered during the piloting of the tools in the partner countries.
- Evaluation Phases and Timeline: The report outlines the main stages of the evaluation process with a corresponding timeline for each stage.
- Evaluation Procedure: This section details the specific procedures used and data analysis to evaluate each type of activity, including career talks, lighthouse activities, and open schooling activities. Notably, it includes the "Observation Template" created by the IE-Lisboa group specifically for assessing lighthouse activities during the pilot phase.
- Evaluation Instruments: the final evaluation instruments for the different activities and the different participants/stakeholders are included.

2. METHODOLOGY

This section describes the overall approach to the evaluation, including data collection methods and analysis techniques.

1.

2.

2.1 Design and Development of the Questionnaires

2.1.1 Explaining the idea behind the evaluation tools

The main purposes of WP 5 according to the proposal are: (a) to ensure activities of the highest quality, and (b) to measure the impact of the activities on participants to give advice to other people interested in open schooling, creating partnerships, providing activities for life long learning. Furthermore, based on the description of WP5, the questionnaires should contain a variety of questions, such as opinion about the activity, attitudes towards science, science careers, self-efficacy in relation to science, importance of lifelong learning, value of cross-

sectoral partnerships, importance of cooperation between community and scientists, frequency of mentoring and value." From now on these are referred to as the nine dimensions of the questionnaire. Therefore, the questionnaires for the Light House Activities (LHA), Interactive Career Talks (ICT), Local Fairs and conventions were designed to measure the nine dimensions as stated in the proposal and highlighted above. According to the proposal, the methodology of the overall project is based on design research, and through the feedback from the evaluation questionnaires the partners are invited to make the necessary changes to the activities. Therefore, the questionnaires for LHA, ICT, Local Fairs etc were designed to capture the following: (a) information about the nine dimensions mentioned above above, (b) information related to the activity that will support partners in making the necessary changes to the activities, and (c) changes in students' self-efficacy, attitudes towards science and science career aspirations for two specific situations: (1) when people participate in multiple activities from the project, and (2) for the Open Schooling Activities that are longer in duration. These decisions are based on the proposal which mentions in page 12: "We will evaluate the change in participants' attitudes (e.g. self-efficacy) when participating in several events of the project. This allows us to draw conclusions about how effective our events are or which activities, possibly also in combination, are effective in achieving individual goals for specific groups."

Therefore, the questionnaires were not designed to measure impact of each individual activity (with the exception of Open Schooling Activities) because: (a) according to the proposal this was not the intention of the evaluation questionnaires for LHA, ICT and Local Fairs, (b) LHA, ICT and Fairs are very short in duration (20-60 minutes) and therefore we did not expect to observe any impact from short activities, and (c) the time it takes to complete the questionnaire is long, and participants did not complete when we tried it in some LHA during the initial piloting. Despite the aforementioned, for the LHA, ICT and Local Fairs and conventions we are measuring possible impact from participating in more than one activity from our consortium, as indicated in the proposal. Each participant will generate their personal code when they fill in a questionnaire and at the end of the project we will measure the impact on participants who have participated in more than one activities in the project and will analyse possible impact on the dimensions of the questionnaires mentioned above (i.e. attitudes towards science, self-efficacy in science).

According to the proposal, questionnaires for LHA, ICT and fairs are only completed at the end of the activity (WP5 description, Task 5.2). The impact of the activities, as mentioned in the proposal is linked to activities of longer duration, as for example Open Schooling Activities. Specifically, impact is mentioned in the proposal in relation to the retrospective interviews for Open Schooling, (page 11 of the proposal, WP 5 description). Therefore, for the Open Schooling Activities, other than the retrospective interviews, students will be administered the questionnaire both as a pre and post test. In this way we will be able to measure the impact of the Open Schooling Activities.

2.1.2 The process of designing the evaluation tools

The initial discussion on the structure of the evaluation tools took place during the kick-off meeting of the project in April 2023. UNIC presented a preliminary structure for the

questionnaire, which was based on the ideas included in the project proposal. Partners were then divided into groups to share their ideas and concerns, fostering a collaborative environment.

During the meeting, the partners emphasized the importance of including questions related to self-efficacy, attitudes, and career aspirations in science as per proposal description. Additionally, they highlighted the need for questions linked to science capital (Archer et al., 2015) as an extra variable to support the consortium in exploring possible relationships between science capital and the other dimentions of the questionnaire (i.e. self-efficacy in science). Science capital includes amongst others education of parents, access to science activities. Following this meeting, UNIC developed the first version of the questionnaire in May 2023, incorporating feedback from the partners.

The design and development of these evaluation tools were informed by a comprehensive review of four existing reliable and valid instruments:

- TIMSS (Trends in International Mathematics and Science Study) scale served as a key reference.
- PISA (Programme for International Student Assessment) 2015 provided elements such as Instrumental Motivation to Learn Science and Career Aspirations.
- The STEM Career Interest Survey (STEM-CIS) contributed insights into students' interest in STEM careers.
- The Eurobarometer survey on attitudes towards science provided valuable information on public opinions about science.

The process of designing, discussing, and brainstorming the questionnaires involved extensive collaboration and iterative review. Partners actively participated in multiple review meetings that were set by WP 5 leaders online (21/09/2023; 31/10/2023; 17/4/2024) and during the project meetings (5/12/2023 and 5/06/2024). This collaborative effort ensured that the final tools were comprehensive and effectively measured various aspects of students' motivation and attitudes towards science.

The TIMSS framework, with its separate questionnaires for science disciplines (e.g., Physics, Chemistry, Biology), significantly influenced the structure of our evaluation tools. This review ensured the tools were grounded in proven methodologies. For example, the TIMSS scale, utilizing a 4-point Likert scale (Agree a lot, Agree a little, Disagree a little, Disagree), served as a key reference point. We further integrated elements from PISA 2015, such as Instrumental Motivation to Learn Science and Career Aspirations. A notable question, "What kind of job do you expect to have when you are 30 years old?", is coded using the International Standard Classification of Occupations (ISCO-88) to distinguish between STEM and non-STEM fields (Ahmed & Mudrey, 2019). Additionally, insights from the STEM Career Interest Survey (STEM-CIS) and PISA's Enjoyment of Science scale were incorporated. The Eurobarometer survey on attitudes towards science provided valuable contributions, focusing on Trust in scientists, Interest in scientific topics, Perception of the impact of science, and Engagement in scientific activities. These dimensions are all measured using Likert scale questions for quantitative data.

2.1.3 The different questionnaires and the dimensions of the questionnaires

Student questionnaires

The student questionnaires were designed to evaluate the different activities in which the students participate, but also **the impact** on students' attitudes towards science, self-efficacy related to science, science career aspirations, importance of lifelong learning, value of cross-sectoral partnerships, importance of cooperation between community and scientists, frequency of mentoring and value when participating in multiple activities, or as a pre- and post-test design for the Open Schooling Activities. Each questionnaire has six parts:

- Part A. Background information (including the generation of a unique code to help us track the impact on partners from the participation in multiple activities, and questions regarding the social capital)
- Part B. Attitudes and beliefs towards science
- Part C. Self-efficacy towards science
- Part D. Interest in science studies and science career
- Part E. Evaluation of Activity (includes question about the importance of cooperation, frequency of mentoring and value, importance of life long learning and value of partnership)
- Part F. Open ended questions to provide feedback for further improvement of activity

In all questionnaires, regardless of the activity (i.e. LHA, OSA, ICT, Local Fairs) Part A to Part D and Part F are the same. However, Part E, which is specific to the evaluation is different in each questionnaire based on the type of the activity.

Initially, the consortium suggested to provide the student questionnaires as pre- and post-test for all activities, even though this is not part of the proposal. Some partners piloted this design, but noted that it was difficult to receive completed questionnaires from both the pre and post-design because of the short length of the activities. Furthermore, after the piloting of all activities, during the meeting on April 17th the partners suggested to remove questions to make the questionnaires shorter. The final version of the questionnaires is included in the Appendix. You can find the initial questionnaires HERE.

Adult questionnaires

Adult questionnaires were designed for specific populations participating in the activities, namely parents, teachers, and other stakeholders (i.e. scientists, people from the industry). Three separate questionnaires were designed originally for these three categories of adult with the main aim evaluating the activity. Therefore, the dimensions included in the student questionnaires in Parts A – Part D were not included in the adult questionnaires. After the initial piloting and analysis of the separate questionnaires (you can find the initial questionnaires HERE), the WP leaders of WP2, WP3 and WP4 in collaboration with WP5 have decided to modify the

questionnaire and design one questionnaire for all adult participants that can be found in this document.

2.1.4 Validity and Reliability

To ensure the content validity of the evaluation instruments, we have undergone several rounds of review by consortium members, within an expert validation process (Creswell, 2014). After the first round, changes were made to the instruments based on the feedback received from the consortium members. The changes consisted mainly of rephrasing some items. This first version was piloted by UNIC in English with 34 students. After the initial piloting the instruments were translated in the languages of the partners and were added in LIME survey. Subsequently, the instruments were piloted by all partners (from mid-November 2023 until the end of March 2024 when LHA and ICT were in action) and the results from the piloting are presented below. After the piloting, minor changes were made to the questionnaires and the final questionnaires are presented in this deliverable. The main changes consisted of reducing the number of items and modifying the wording of some of them based on qualitative feedback that was provided by the partners, and the WP leaders for the LHA and the ICT.

For the analysis of the internal consistency and the adequacy of the dimension model proposed for the questionnaire, Cronbach's Alpha coefficient was calculated (Creswell, 2014). In the case of open-ended questions, these will be used by each partner as quality assurance feedback to further improve their activities and they will be analysed using open coding.

2.2 Piloting of the questionnaire and description of the sample

2.2.1 Sample for students' questionnaire

A total of 583 full[1] questionnaires from all the partner countries were analysed. The sample sizes are detailed in Table 1. Table 2 show the sample sizes by gender and country and Table 3 by type of activity.

Table 1. Sample sizes for the students' questionnaires by country.

	Turkey	Germany	Croatia	Portugal	Cyprus	Total
Pre-test	91	7	45	0	0	143
Post-test	74	115	193	13	45	440
Total	165	122	238	13	45	583

[1] Questionnaires that were not completed from beginning to end were not calculated

Table 2. Sample sizes for the students' questionnaires by gender and country.

	Turkey		Germany			Croatia		Portugal		Cyprus		
	Female	Male	Female	Male	Other	Female	Male	Female	Male	Female	Male	Other
Pre-test	50	41	3	4	0	29	16	0	0	0	0	0
Post-test	30	44	64	49	2	108	85	8	5	31	13	1
Total	80	85	67	53	2	137	104	8	5	31	13	1

Table 3. Sample sizes for the students' questionnaires by type of activity and country.

	Turkey				Germany				Croatia				Portugal				Cyprus			
	ICT	LHA	OSA	LSF	ICT	LHA	OSA	LSF	ICT	LHA	OSA	LSF	ICT	LHA	OSA	LSF	ICT	LHA	OSA	LSF
Pre-test	1	33	43	14	0	2	4	1	0	24	21	0	0	0	0	0	0	0	0	0
Post-test	**33**	**25**	13	3	**34**	**25**	28	28	**7**	**154**	24	8	**13**	**0**	0	0	**12**	**33**	0	0
Total	34	58	56	17	34	27	32	29	7	178	43	8	13	0	0	0	12	33	0	0

2.2.2 Sample for adults' questionnaire

A total of 140 full questionnaires were analysed. The sample sizes are detailed in Tables 4, 5 and 6.

Table 4. Sample sizes for the adults' questionnaires by country.

	Turkey	Germany	Croatia	Portugal	Cyprus	Total
Parents	50	0	2	0	0	52
Teachers	28	9	1	15	0	53
Scientists/Industry	10	23	0	2	0	35
Total	88	32	3	17	0	140

Table 5. Sample sizes for the adults' questionnaires by gender and country.

	Turkey		Germany			Croatia		Portugal		Cyprus		Total		
	Female	Male	Female	Male	Other	Female	Male	Female	Male	Female	Male	Female	Male	Other
Parents	29	13	0	0	0	0	0	0	0	0	0	29	13	0
Teachers	16	8	5	2	0	0	0	0	0	0	0	21	10	0
Scientists/Industry	6	3	16	3	1	1	0	0	0	0	0	23	6	1
Total	51	29	21	5	1	1	0	0	0	0	0	73	34	1

Table 6. Sample sizes for the students' questionnaires by type of activity and country.

	Turkey					Germany				Croatia				Portugal				Cyprus			
	ICT	LHA	OSA	LSF	Not specified	ICT	LHA	OSA	LSF	ICT	LHA	OSA	LSF	ICT	LHA	OSA	LSF	ICT	LHA	OSA	LSF
Parents	1	41	4	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Teachers	2	22	4	0	0	4	3	2	0	0	1	0	0	0	12	1	2	0	0	0	0
Scientists/ Industry	1	8	1	0	0	1	19	1	1	0	1	0	0	0	0	0	2	0	0	0	0
Total	4	71	9	4	2	5	22	3	1	0	2	0	0	0	12	1	4	0	0	0	0

2.2.3 Validity of students' questionnaires

The validity of the questionnaire was analysed using Cronbach's Alpha coefficient. The results of both analyses are shown in Table 8. Table 7 presents the scales of good Cronbach's Alpha to support the interpretation of Table 8.

Table 7. *Summary of reference values for interpreting the goodness of fit of the Cronbach's Alpha coefficient and the adjustment indices for the Confirmatory Factor Analysis (Byrne, 1994; Costa & Sarmento, 2019;* ***Hu & Bentler, 1998; 1999****).*

	Very good	Good/acceptable	Suffering/questionable	Bad/unacceptable
Cronbach's Alpha	≥ 0.9	0.89 – 0.70	0.69 – 0.60	≥ 0.59
χ^2/df	≤ 1	1 – 2	2 – 5	> 5
CFI	≥ 0.95	0.9 – 0.95	0.8 – 0.9	< 0.8
TLI	≥ 0.95	0.9 – 0.95	0.8 – 0.9	< 0.8
SRMR	≤ 0.08	0.08 – 0.09	0.09 – 0.10	> 0.10
RMSEA	≤ 0.05/0.06	0.05/0.06 – 0.08	0.08 – 0.10	> 0.10

Table 8. Cronbach's Alpha coefficient for the students' questionnaires (pretest and posttest) for each country.

	Turkey		Germany		Croatia		Portugal	Cyprus
	Pre (N=91)	Post (N=74)	Pre (N=7)	Post (N=115)	Pre (N=45)	Post (N=193)	Post (N=13)	Post (N=45)
Cronbach's Alpha	0.921	0.954	0.958	0.938	0.917	0.945	0.909	0.940

Cronbach's Alpha Part B	0.811	0.892	0.917	0.875	0.746	0.855	0.778	0.869
Cronbach's Alpha Part C	0.815	0.944	0.950	0.905	0.889	0.903	0.875	0.876
Cronbach's Alpha Part D	0.799	0.858	0.608	0.900	0.827	0.847	0.769	0.714
Cronbach's Alpha Part E		0.936		0.863		0.923	0.936	0.936
Global evaluation	●	●	●	●	●	●	●	●

Cronbach's alpha coefficient has been calculated for each dimension of the questionnaire (Dimensions B-D) for the sole purpose of analysing the internal consistency of the items of each dimension. As shown in Table 8, Cronbach's Alpha is good or very good for all questionnaires in all partner languages, and all sections of the questionnaires, with the exception of Part D for Germany. This might be explained by the participants in Germany, that were very young (5-8 year olds).

2.2.4 Adults' questionnaires

In the case of the adults' questionnaires (parents, teachers, scientists), Cronbach Alpha for the entire questionnaire was calculated, because there were not dimensions in the questionnaire. The results are shown in Table 9, showing the Cronbach's Alpha is good for all questionnaires.

Table 9. *Cronbach's Alpha coefficient for the adults' questionnaire (teachers, parents and scientists/industry) for each country.*

	Turkey	Germany	Croatia	Portugal	Cyprus
Cronbach's Alpha Parents	0.887 (N=59)	ND	Error (N=2)	ND	ND
Cronbach's Alpha Teachers	0.917 (N=28)	0.869 (N=9)	Error (N=1)	0.928 (N=15)	ND
Cronbach's Alpha Scientists/Industry	0.885 (N=10)	0.906 (N=23)	ND	Error (N=2)	ND
Global evaluation	●	●	●	●	●

3. PRELIMINARY RESULTS

This is a preliminary analysis of the questionnaires from the piloting phase. In section 2 we presented the preliminary validity and reliability analysis of the questionnaires. For this analysis we used all the full questionnaires available to date, independently of the type of activity. In section 3 the preliminary results of data available to date both from students and adults (teachers, parents, and scientist/industry) are presented. However, for this analysis, we only used the data from ICT and LHA, because in the piloting phase no Open Schooling Activities and Local Science Fairs were conducted.

3.1. Analysis of students' questionnaires for Parts A-D

The following variables have not been analysed for the piloting:

- A04.Mother's_profession
- A05.Father's_profession
- A076.Other
- A09.Subject_when_think_of_science
- Part E questions

Only results from ICT and LHA activities (because no OSA or LSF were planned for the piloting phase) and we have only used the data from the post-test (because they were supposed to be evaluated only after the activity).

Table 10. Interactive career talks/country

	Turkey		Germany		Croatia		Portugal		Cyprus	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
B.Attitudes and beliefs toward science										
B01.I enjoy learning science*	4.33	1.31	3.68	1.25	3.71	0.488	4.54	0.66	4.42	0.793
B02.I wish I did not have to study science	2.06	1.48	1.82	1.19	2.86	1.07	1.46	0.66	1.83	1.03
B03.Science is boring*	1.61	1.17	1.76	1.07	2.43	1.4	1.85	0.899	1.58	0.669
B04.I learn many interesting things in science	4.09	1.07	3.76	1.16	4.43	0.787	4.31	0.855	4.58	0.669
B05.I look forward to learning science in school	3.64	1.19	3.59	1.1	3.86	1.07	2.92	1.44	3.33	1.3
B06.Science teaches me how things in the world work*	4.03	1.31	3.79	1.07	4.29	0.756	4.38	0.87	2.83	1.34
B07.I like to do science experiments	4.12	1.32	3.94	1.07	4	0.816	4.46	0.877	4.17	1.03
B08.Science is one of my favorite subjects	3.67	1.24	3.47	1.52	4.43	1.13	4	1.15	3.83	1.34
B09.Learning science will help me in my daily life	3.67	1.34	3.56	1.02	3.86	0.69	4.23	0.927	3.83	1.19
B10.I need to do well in science to get the job I want*	4.18	1.4	2.82	1.45	4	1	4.62	0.768	3.58	1.51
C.Self-efficacy towards science										
C01.Science is harder for me than for many of my classmates	1.82	1.04	2.09	1.22	2.43	0.976	1.69	0.751	2.17	1.11
C02.Science is harder for me than any other subject*	1.58	1.12	2.06	1.23	2.57	1.27	1.69	1.11	2.25	1.22
C03.I can understand scientific concepts*	4.15	1.12	3.91	0.9	4.14	0.9	4.38	0.506	3.75	0.754
C04.I can use scientific concepts to answer questions*	3.97	1.24	3.5	1.02	3.86	1.07	4.46	0.519	3.83	0.937
C05.I can conduct scientific experiments*	4.06	1.12	3.71	1	3.86	0.9	4.46	0.519	3.17	1.4
C06.I can critically analyze scientific information and draw conclusions	4.09	1.07	3.35	1.18	4.14	0.9	4.31	0.63	3.67	1.07
C07.I can communicate effectively about scientific topics with others	3.94	1.25	3.53	1.13	3.71	1.25	4.46	0.776	3.42	0.9
C08.I can solve problems using scientific methods and techniques*	4.06	1.3	3.32	1.04	3.57	1.27	4.46	0.66	3.83	1.19
C09.I can apply scientific principles to real-world situations*	4.15	1.23	3.44	1.05	3.57	1.13	4.23	0.927	3.5	1.24
C10.I can learn and use scientific skills, such as data analysis*	4.24	1.12	3.21	1.17	3.86	1.21	4.23	0.725	3.42	0.996
C11.I can engage in scientific inquiry and ask relevant research questions*	4.12	1.24	3.5	1.05	4	0.816	3.92	1.26	3.08	0.793

C12.I am confident I can succeed in a scientific career*	4.21	1.02	3.38	1.46	3.86	0.9	4.31	0.751	3.33	1.44
C13.I am confident I can successfully pursue studies in science*	4.03	1.24	3.38	1.48	3.86	0.69	4.46	0.66	3.5	1.38
D.Interest in science studies and science career										
D01.Making an effort in science is worth it because this will help me acquire the skills required for my future career	4.15	1.39	3.41	1.18	4	0.816	4.31	1.03	3.58	1.31
D02.What I learn in science is important because I need this for what I want to do later on*	4.15	1.28	3.15	1.37	4.57	0.535	4.38	0.768	3.42	1.16
D03.The skills/knowledge learn in science will help me to get a job*	4.36	1.19	3.15	1.33	4.57	0.787	4	1.08	3.5	1.24
D04.My family would like me to choose a science career	4.36	1.08	3.38	1.16	3.57	1.13	3.85	1.07	3.5	1.51
D05.I am interested in careers that use science, mathematics or technology*	4.45	1.03	3.56	1.4	4	1.15	4.54	0.877	3.83	1.11
D06.I would like to study science related fields at university*	4.15	1.12	3.06	1.46	4	1	4.54	0.66	3.67	0.985
D07.I have a role model working in science related field*	3.85	1.28	2.62	1.52	4.29	0.756	4.23	0.927	3.5	1.57
D08.A family member of mine works in a science related field	3.3	1.86	3.44	1.65	3.57	1.9	2.69	1.84	3.33	1.3
D09.I enjoy talking to scientists*	4.24	1.25	3.5	1.21	3.43	1.4	4.08	0.76	3.67	1.15
E.Evaluation of activity										
E01.Was fascinating	4.15	1.06	3.79	1.04	4.29	0.951	4.23	0.832	4	1.28
E02.Helped me learn new concepts*	4.3	1.21	3.29	1.29	4.29	0.951	4.15	0.899	4.17	0.937
E03.Helped me obtain new skills*	4.03	1.19	3.15	1.31	4.43	0.976	3.46	1.51	4.17	1.03
E04.Required that I collaborate with other students*	3.7	1.26	2.79	1.45	4.29	0.951	2.69	1.38	4	1.28
E05.Required that I collaborate with scientists*	4.03	1.16	3.32	1.34	4	1.15	2.69	1.6	3.58	1.62
E06.Required that I collaborate with people from industry	3.7	1.21	2.68	1.43	3.86	1.07	3.23	1.24	3	1.48
E07.Helped me to understand the connection of science to everyday	4.21	1.14	3.44	1.19	4	1.15	3.85	1.46	3.92	1.38
E08.The activity helped me solve a real problem*	3.73	1.23	2.44	1.44	3.71	1.38	3.15	1.41	3.42	1.73
E09.The activity helped me participate in decision making*	3.97	1.21	2.82	1.29	3.71	1.11	4.15	1.14	4.17	1.27
E10.The activity helped me understand the importance of cooperation between community and scientists	4.24	1.12	3.32	1.22	3.71	0.756	3.77	1.48	4.17	1.19
E11. I had constructive communication with mentors during the activity	4.06	1.39	3.5	1.24	4.14	0.9	3.92	1.32	3.92	1.31
N	33		34		7		13		12	

*Presence of statistically significant differences. None of the variables follow a normal distribution (Kolmogorov-Smirnov test), so non-parametric tests were applied (chi-square).

Table 11. Lighthouse activities/country

	Turkey		Germany		Croatia		Cyprus	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
B.Attitudes and beliefs toward science								
B01.I enjoy learning science*	4.48	0.92	2.96	1.43	4.07	0.85	4.12	0.857
B02.I wish I did not have to study science	1.68	1.22	2.52	1.39	2.4	1.36	2.03	1.1
B03.Science is boring	1.44	0.96	2.28	1.21	1.81	1	1.58	0.902
B04.I learn many interesting things in science*	4.28	1.17	3.8	1	4.36	0.78	4.33	0.645
B05.I look forward to learning science in school*	3.84	1.46	3.32	1.35	3.83	0.99	3.39	1.09
B06.Science teaches me how things in the world work*	3.84	1.49	3.92	1.04	4.27	0.78	2.97	1.02
B07.I like to do science experiments*	4.32	1.18	3.76	1.05	4.29	0.88	4.09	1.01
B08.Science is one of my favorite subjects*	4.2	1.12	2.8	1.44	3.92	1.09	3.88	1.05
B09.Learning science will help me in my daily life*	4.16	1.28	2.92	1.04	3.97	0.98	3.67	1.14
B10.I need to do well in science to get the job I want*	3.96	1.24	2.6	1.22	3.82	1.14	4.03	0.918
C.Self-efficacy towards science								
C01.Science is harder for me than for many of my classmates*	1.56	1.16	1.92	0.95	1.87	1.14	2.33	0.854
C02.Science is harder for me than any other subject*	1.76	1.16	2.28	1.1	2.29	1.32	2.91	1.16
C03.I can understand scientific concepts	4.24	0.83	3.52	1	3.91	0.9	3.79	0.74
C04.I can use scientific concepts to answer questions*	4.28	0.94	3.36	1	3.96	0.98	3.85	0.755
C05.I can conduct scientific experiments*	4.28	1.1	3.48	1.19	4.08	0.91	3.42	1.03
C06.I can critically analyze scientific information and draw conclusions*	4.2	1	2.92	1.15	3.94	0.88	3.42	0.867
C07.I can communicate effectively about scientific topics with others*	4	1	2.8	1.32	3.75	0.97	3.55	0.971
C08.I can solve problems using scientific methods and techniques*	4.32	0.95	2.96	1.27	3.87	0.92	3.64	0.962
C09.I can apply scientific principles to real-world situations*	4.16	1.21	2.84	1.14	3.9	0.94	3.73	0.911
C10.I can learn and use scientific skills, such as data analysis*	4.28	0.89	2.8	1.26	4.01	0.97	3.85	0.755
C11.I can engage in scientific inquiry and ask relevant research questions*	4.24	1.05	2.88	1.13	3.9	1.02	3.64	0.962
C12.I am confident I can succeed in a scientific career*	4.08	1.26	3	1.32	3.72	1.11	3.88	0.96
C13.I am confident I can successfully pursue studies in science*	4.2	1.19	2.64	1.38	3.82	1.11	3.82	1.04
D.Interest in science studies and science career								
D01.Making an effort in science is worth it because this will help me acquire the skills required for my future career*	4.36	0.81	2.92	1.32	3.96	1.07	4.24	0.663
D02.What I learn in science is important because I need this for what I want to do later on*	4.4	0.91	2.8	1.32	4.14	0.92	4.03	1.1
D03.The skills/knowledge learn in science will help me to get a job*	4.12	1.24	2.84	1.14	3.9	1.07	4.18	0.882
D04.My family would like me to choose a science career*	3.76	1.42	2.96	1.24	3.25	1.19	3.85	0.972

D05.I am interested in careers that use science, mathematics or technology*	4.48	0.77	3.04	1.49	3.86	1.21	4.06	0.899
D06.I would like to study science related fields at university*	3.6	1.19	2.6	1.35	3.88	1.16	4.27	0.801
D07.I have a role model working in science related field*	3.8	1.29	2.68	1.31	3.49	1.36	3.76	1.28
D08.A family member of mine works in a science related field*	2.64	1.78	2.72	1.37	3.32	1.58	3.21	1.52
D09.I enjoy talking to scientists*	4.28	1.1	2.64	1.32	3.81	1.13	3.76	1.09
E.Evaluation of activity								
E01.Was fascinating*	3.92	1.55	3.6	1.04	4.16	0.93	4	1.03
E02.Helped me learn new concepts*	4.08	1.38	3.44	0.82	4.08	1.08	4.18	0.95
E03.Helped me obtain new skills*	4	1.5	3.28	0.98	4	1.07	3.94	1.03
E04.Required that I collaborate with other students*	2.96	1.72	3.52	1.29	4.08	1.24	3.76	1.25
E05.Required that I collaborate with scientists*	3.2	1.61	2.8	1.08	4.07	1.13	3.55	1.18
E06.Required that I collaborate with people from industry*	2.88	1.56	2.72	1.28	3.84	1.27	3.18	1.21
E07.Helped me to understand the connection of science to everyday*	4	1.35	3.24	1.23	4.19	1.05	3.94	0.998
E08.The activity helped me solve a real problem*	4	1.47	2.92	1.19	3.72	1.21	3.64	1.22
E09.The activity helped me participate in decision making*	3.84	1.43	2.96	1.06	3.87	1.13	3.85	1.09
E10.The activity helped me understand the importance of cooperation between community and scientists*	3.56	1.61	2.84	0.9	4.12	1.1	3.67	1.14
E11. I had constructive communication with mentors during the activity*	3.32	1.68	3.24	1.16	3.97	1.2	3.55	1.23
N	25		25		154		33	

*Presence of statistically significant differences. None of the variables follow a normal distribution (Shapiro-Wilks and Kolmogorov-Smirnov tests), so non-parametric tests were applied (chi-square).

3.2 Analysis of adults participants questionnaires

Data from parents and scientists were not available. Therefore only data from teachers are presented.

Table 12. Interactive career talks/country

	Turkey		Germany		Croatia		Portugal		Cyprus	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Parents										
C01.The activity was captivating and held my child's interest										
C02.My child learned new ideas from the activity										
C03.The activity helped my child develop new skills										
C04.The activity fostered teamwork among children										
C05.The activity enabled my child to collaborate with scientist										
C06.The activity demonstrated the practical applications of sci										
C07.The activity provided a real-world problem that my child co										
C08.The activity encouraged my child to participate in decision										
C09.The activity showed the importance of collaboration between										
C10.My child had communication with other participants during t										
C11.My child often does hands on activities at home										
N	1		0		0		0		0	
Teachers										
B01.The activity was captivating for the students	4.5	0.707	4.25	0.5						
B02.The activity kept students engaged	4.5	0.707	4	0.816						
B03.The activity taught new ideas that I can integrate into my lessons	3	1.41	3.25	1.26						
B04.The activity provided opportunities for students to acquire new skills	4.5	0.707	3.25	1.26						
B05.The activity fostered teamwork among students	3	0	3.25	0.957						
B06.The activity enabled students to collaborate with scientists or professionals from industry	4.5	0.707	3.75	0.957						
B07.The activity demonstrated the practical applications of science in everyday life	5	0	4.25	0.5						
B08.The activity provided a real-world problem that students could solve	5	0	3.5	1.91						
B09.The activity encouraged students to participate in decision-making processes	5	0	2.5	1						
B10.The activity highlighted the importance of collaboration between scientists and the community	5	0	3.5	1						

B11.I had frequent communication with different stakeholders during the activity	3.5	0.707	2.5	0.577		
B12.Beyond this project I engage with my students in hands on science activities in the class	3	2.83	3.5	1.29		
N	2		4		0	0	0
Scientists/industry						
D01.The activity was captivating and held my interest						
D02.The activity helped me communicate scientific concepts or i						
D03.The activity provided opportunities for students to acquire						
D04.The activity fostered teamwork and collaboration among stud						
D05.The activity enabled me to collaborate with other scientist						
D06.The activity demonstrated the practical applications of sci						
D07.The activity provided a real-world problem that could be so						
D08.The activity encouraged students to participate in decision						
D09.The activity highlighted the importance of collaboration be						
D10.I had frequent communication with other stakeholders during						
D11.I often get involved with hands on activities with students						
N	1		1		0	0	0

*Presence of statistically significant differences. None of the variables follow a normal distribution (Shapiro-Wilks and Kolmogorov-Smirnov tests), so non-parametric tests were applied (chi-square)

Table 13. Lighthouse activities/country

	Turkey		Germany		Croatia		Portugal		Cyprus	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Parents										
C01.The activity was captivating and held my child's interest	4.44	0.594								
C02.My child learned new ideas from the activity	4.56	0.673								
C03.The activity helped my child develop new skills	4.51	0.675								
C04.The activity fostered teamwork among children	3.9	1.28								
C05.The activity enabled my child to collaborate with scientist	4.24	0.969								
C06.The activity demonstrated the practical applications of sci	4.66	0.617								
C07.The activity provided a real-world problem that my child co	4.46	0.809								
C08.The activity encouraged my child to participate in decision	4.32	0.82								
C09.The activity showed the importance of collaboration between	4.46	0.84								
C10.My child had communication with other participants during t	4	1.32								
C11.My child often does hands on activities at home	3.95	1.07								
N	41		0		0		0		0	
Teachers										
B01.The activity was captivating for the students	4.64	0.492	3.33	2.08			4.08	0.9		
B02.The activity kept students engaged*	4.64	0.658	3.33	2.08			3.92	0.793		
B03.The activity taught new ideas that I can integrate into my lessons*	4.73	0.55	2.67	2.08			4.08	0.996		
B04.The activity provided opportunities for students to acquire new skills*	4.68	0.646	3	1.73			4.25	0.754		
B05.The activity fostered teamwork among students	4.55	0.912	3.33	1.15			3.83	1.11		
B06.The activity enabled students to collaborate with scientists or professionals from industry*	4.5	0.802	2.33	2.31			3.92	0.9		
B07.The activity demonstrated the practical applications of science in everyday life*	4.64	0.79	3.67	2.31			4.17	0.718		
B08.The activity provided a real-world problem that students could solve*	4.73	0.456	2.33	2.31			4.17	0.577		
B09.The activity encouraged students to participate in decision-making processes*	4.55	0.858	3.33	2.08			3.92	0.793		
B10.The activity highlighted the importance of collaboration between scientists and the community*	4.68	0.78	3.33	2.08			3.92	0.793		
B11.I had frequent communication with different stakeholders	4.64	0.581	2.67	1.53			3.58	0.996		

during the activity*								
B12.Beyond this project I engage with my students in hands on science activities in the class*	4.64	0.79	3.33	2.08		4.17	0.718	
N	22		3		1	12		0
Scientists/industry								
D01.The activity was captivating and held my interest	4.5	0.535	4.26	1.15				
D02.The activity helped me communicate scientific concepts or i	4.13	1.13	3.63	1.26				
D03.The activity provided opportunities for students to acquire	4.38	1.06	4.26	0.872				
D04.The activity fostered teamwork and collaboration among stud	4.75	0.463	3.84	1.34				
D05.The activity enabled me to collaborate with other scientist	3.75	1.75	3.05	1.65				
D06.The activity demonstrated the practical applications of sci	4.25	1.39	4.53	0.772				
D07.The activity provided a real-world problem that could be so	4.13	1.13	3.79	1.47				
D08.The activity encouraged students to participate in decision	4.25	1.39	3.53	1.22				
D09.The activity highlighted the importance of collaboration be	4	1.07	4.16	1.38				
D10.I had frequent communication with other stakeholders during	4.38	1.06	3.95	1.08				
D11.I often get involved with hands on activities with students	4.38	0.916	3.32	1.2				
N	8		19		1	0		0

*Presence of statistically significant differences. None of the variables follow a normal distribution (Shapiro-Wilks and Kolmogorov-Smirnov tests), so non-parametric tests were applied (chi-square).

4. EVALUATION PHASES AND TIMELINE

1.

T5.1 Development of evaluation instruments (m1-14) (Jan 2023-Feb 2024)

M5.1. The instruments was piloted during m7-12 (July 2023-December 2024) and refined.

Role of participants: The country partners provided feedback to the evaluation instruments.

T5.2 Data collection (m15-32) (March 2024-August 2025)

In each country, we will collect data after lighthouse activities and interactive career talks through the post-test and before and after open schooling activities through the pre-test/post-test. Additionally, we will conduct individual interviews with teachers and focus groups with students on open schooling activities. For collecting and evaluating the data we use a data protection compliant, digital, coded-anonymized system. This enables us to examine the participant behavior and beliefs in compliance with the European (European Union, 2016) and national data protection acts (Federal Ministry of Justice, 2017).

Role of participants: The country partners will be responsible for the local data collection.

T5.3 Data evaluation (m27-35) (March 2025-November 2025)

The questionnaires will be analysed centrally by UNIC, whilst the interviews will be analysed in the respective country due to language reasons. Based on the interviews each country team will write an individual country-case study. For this purpose, UNIC will develop a framework with questions for the case study (see above T5.1). UNIC will evaluate these country-case studies internationally and write a cross-case study. The results of the evaluation will be discussed in a validation workshop with the consortium. In the end, all results (of the quantitative questionnaires and the case studies) will be summarized in the evaluation report.

Role of participants: Country partners will be responsible writing the case studies, with science education experts from the consortium taking the lead. The WP lead will evaluate the questionnaires centrally and write the cross-case study.

In Figure 1 you can see a scheme of the timeline of the evaluation of the activities.

5. EVALUATION PROCEDURE

This section presents the information about the implementation dates and the evaluation procedure and data analysis for each activity: career talks (Woods-Townsend *et al*. 2016), lighthouse activities (Blades, 2011; UNFCCC, 2017) and open schooling activities (European Union, 2015; Sotiriou *et al*., 2017; 2021; Bogner & Sotiriou, 2023).

2.

5.1 Lighthouse activities (LHA)

- **Piloting phase:** from mid-November 2023 until the end of March 2024. 3 per country.
- **Implementation phase:** until March 2025 you need to complete 27 LHA (Table 14), after that is going to be extra.
- **Evaluation: The LHA will be evaluated after the activity (post-test only) by means of questionnaires** (Table 15)**. The questionnaires will be filled in by students (see Appendix I) as well as by adults (see Appendix II). The** "Observation Template" for LHA can be consulted in Appendix VI.

5.2 Interactive career talks (ICT)

- **Piloting phase:** from mid-November 2023 until the end of March 2024. 1-2 per country.
- **Implementation:** from January 2023 to March 2024. 8 ICT per country (Table 14).
- **Evaluation: The ICT will be evaluated after the activity (post-test only) by means of the same questionnaire as for LHA** (Table 15)**. The questionnaires will be filled in by students (see Appendix I) as well as by adults (see Appendix II) at the end of each activity.**

5.3 Open schooling activities (OSA)

- **Piloting phase:** from mid-November 2023 until the end of March 2024. Although it is not necessary to carry out OSA during the piloting phase, OSA can already begin to be carried out if the teachers would like to and feel ready.
- **Implementation:** from March 2024 to February 2025. 40 per country (Table 14).
- **Evaluation:** The OSA will be evaluated before and after the activity (pre-test and post-test) by means of the same questionnaire as for LHA and ICT (Table 15). The questionnaires will be filled in by students as well as by adults.

  In addition, case studies will be developed for the evaluation of OSA. In these case studies, interviews with teachers and focus groups with students will be conducted. Each country will develop 1 case study. Each case study consists of 3 individual interviews with teachers (before and after the OSA) and a focus group with students (after the OSA).

  As for the teacher interviews, it is intended that the initial interview (before the OSA) will be shorter than the final one (after the OSA), which will be more in-depth, as participation in interviews requires a great effort and it could be counterproductive to ask for two in-depth interviews. For this reason, it is recommended to conduct the initial interview (appendix III) in writing, so that teachers can take as much time as they wish to submit their answers. In both cases (the initial interview in Appendix III and the retrospective interview in Appendix IV) it is recommended that the teachers (in the case of Appendix III) and the interviewers (in the case of Appendix IV) have both the main questions and the supporting questions at their disposal, as these may be useful for them to provide/obtain more in-depth information.

  As for the focus groups with students, they will be conducted only after the activity (retrospective focus group only). The idea of this focus group is to be able to compare the information provided by the teachers in the retrospective interviews with that provided by the students in the focus group, in order to contrast both perceptions (see Appendix V with the questions for the focus group).

Table 14. Number of activities and participants.

Type of activity	N° of activities/country	N° of participants/activity	N° of participants/country	Europe
Lighthouse activities	27	10-15	≈300	≈1500
Open schooling activities	40	5-8	≈250	≈1250
Interactive career talks	10	10-15	≈120	≈600
Local fairs	2	30-50	60-100	300-500

Table 15. Evaluation instruments to be used for each type of activity.

Type of activity	Pre-test	Post-test	Observation template	Initial individual interview	Retrospective individual interview	Retrospective focus group
Lighthouse atividities	----	Students Adults	During the activity	----	----	----
Interactive career talks[2]	----	Students Adults	----	----	----	----
Open schooling activities	Students Adults	Students Adults	----	3 with teachers	3 with teachers	1 with students
Local fairs	----	Students Adults	----	----	----	----

6. DATA ANALYSIS

To assess the impact of the interactive career talks, lighthouse activities, and open schooling activities, a mixed-methods approach will be employed. Descriptive statistics will be used to analyze participant responses across the nine key dimensions for all activities. These dimensions will collect participants' opinions about the specific activity, attitudes towards science and science careers, participants' self-efficacy in science, the importance of lifelong learning, the value of cross-sectoral partnerships and community-scientist cooperation, and the frequency and value of mentorship in science. Additionally, participants will be invited to share their feedback on the specific activities they participated in. The impact of the LHA, ICT, Local Fairs and conventions will be measured by comparing the effects of the activities on students‘ self efficacy towards science, attitudes towards science, career aspirations in science, importance of life long learning, when participating in multiple project activities. Therefore, a specific analysis will be contacted for students who have participated in more than one activities by the end oft he project.

[2] Everyone present in the ICT should complete the questionnaire. In some cases parents might participate in these talks as these might take place outside of the school time.

For open schooling activities, a pre- and post-test design will be implemented to measure the impact of open schooling by measuring the changes in participants' attitudes across these same dimensions, providing a more comprehensive evaluation of the impact. The reliability and validity of the data will be continuously monitored throughout the project lifecycle. Cronbach's Alpha coefficient will be calculated to assess internal consistency(Creswell, 2014). In addition, interviews with teachers and focus groups with students will be conducted to obtain qualitative data to complement the quantitative information. The reliability of the qualitative analyses will be studied by calculating reliability measures such as the percentage of agreement or Cohen's Kappa coefficient.

This combined quantitative and qualitative approach will provide a rich picture of how these activities influence participants' attitudes, self-efficacy, and career aspirations related to science and science-related fields and will provide information about the impact oft he project. Ultimately, this will contribute to the overall project goals of creating new cross-sectoral partnerships, promoting real-life problem-solving skills, encouraging the pursuit of science studies and careers, and fostering a culture of mentorship in science.

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8. APPENDIX 1. Students' questionnaire for OS, ICT, ICT, Local Fairs

3.

4.

5.

The purpose of the questionnaire is:

- to evaluate the different activities (lighthouse activities, open schooling, interactive career talks),
- to evaluate the impact on students students' self-efficacy, attitudes, carreer aspirations when participating in more than one activities of the project,

Explaining the logic:

- The questionnaire is brief as some of the activities are brief as well (i.e. the interactive career talks and LHA)
- **Part A - Part D and Part F in the student questionnaires are the same for the evaluation of all the activities. Part E is specific to each type of activity (i.e. LHA, ICT)**
- We want to track students' participation in order to measure impact from participating in the different activities, and this is why we want to create a code name,
- A first version of the questionnaire was piloted in English and then adapted and translated in the partner languages. The questionnaires were piloted in the partner languages during the first 18 months of the project.

Students' questionnaire

[Please provide the evaluation moment: pre-test ☐ post-test ☐]

[Please provide the name of the activity]:

Partner(s) involved in designing the activity

[Please provide the name of the partner(s) involved in the activity]**:**

[Please add the date]:

Part A. Background information

Code Name: … … … … … … … … [the initial of your name/the number of the day you were born (i.e. if it was July 15 write 15)/the initial of your mother's name]
Age:
Gender:

I participate in science-related activities, such as: (you can check more than one)

- **science museums ☐**
- **science festivals ☐**
- **science-related education programs ☐**
- **field trips ☐**
- **astronomy observations ☐**
- **other (please indicate) ☐**
- **none of the above ☐**

Where do you gain scientific knowledge from? (you can check more than one)

- media/online ☐
- school ☐
- parents ☐
- friend ☐
- activities happening out of school ☐

Type of activity you are attending (you can check only one):
Lighthouse activity ☐ Open schooling activity ☐ Interactive career talks ☐

Mention the name of the activity: … … … …

All questions that follow in part B are about science. Which subject comes to mind when you listen to the word science? Answer the questions in Part B having this subject in mind (you can check more than one)
Biology ☐ Chemistry ☐ Physics ☐ Mathematics ☐ Other/s: … … … …

Part B. Attitudes and beliefs towards science

Please indicate your level of agreement or disagreement on the following statements using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree)					
Statements	1	2	3	4	5
1. I enjoy learning science					
2. Science is interesting					
3. I like to do science experiments					
4. Learning science will help me in my daily life					
5. I need to do well in science to get the job I want					

Part C. Self-efficacy towards science

Please indicate your level of agreement or disagreement on the following statements using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree)					
Statements	1	2	3	4	5
1. Science is harder for me than any other subject					
2. I can apply scientific knowledge to real-world situations					
3. I can learn and use scientific skills					
4. I can communicate effectively about scientific topics with others					
5. I am confident I can succeed in a scientific career					

Part D. Interest in science studies and science career

Please indicate your level of agreement or disagreement on the following statements using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree)					
Statements	1	2	3	4	5
1. Learning science is important for my future career					

2. I am interested in careers that use science, mathematics or technology					
3. I enjoy talking to scientists					
4. A family member of mine works in a science related field					

THE NEXT PART OF THE QUESTIONNAIRE (PART E) IS SPECIFIC TO THE TYPE OF ACTIVITY THAT IS EVALUATED (OPEN SCHOOLING, LHA, ICT ETC).

Part E. Evaluation of Open Schooling Activity

Please indicate your level of agreement or disagreement on the following statements using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree)					
This activity:	1	2	3	4	5
1. Was enjoyable					
2. Helped me learn new concepts					
3. Helped me obtain new skills					
4. Required that I collaborate with other students					
5. Required that I collaborate with scientists					
6. Required that I collaborate with people from industry					
7. Helped me to understand the connection of science to everyday life					
8. The activity helped me solve a real problem					
9. The activity helped me participate in decision making					
10. The activity helped me understand the importance of cooperation between community and scientists					
11. I had constructive communication with mentors during the activity.					

Part F. Open-ended questions

1. What did you like the most in this activity?

2. **What would you like to do differently in this activity?**

3. **How well did you interact with scientists in the activity? In which way did you interact with them?**

Part E. Evaluation of Light House Activity

Please indicate your level of agreement or disagreement on the following statements using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree)					
This activity:	**1**	**2**	**3**	**4**	**5**
1. Was enjoyable					
2. Helped me learn new concepts					
3. Helped me to understand the connection of science to everyday life					
4. The activity helped me understand the importance of cooperation between community and scientists					
5. Required to interact with other participants (students, scientists, people from the industry)					

Open-ended questions

1. **What did you like the most in this activity?**

2. What would you like to do differently in this activity?

Part E. Evaluation of Interactive Career Talks

Please indicate your level of agreement or disagreement on the following statements using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree)					
This activity:	1	2	3	4	5
1. The activity helped me to understand the connection of science to everyday life					
2. The guest speaker(s) clearly presented their career path and I learned something new about their profession from their presentation.					
3. I believe that the activity was useful for me personally and I had the opportunity to actively participate in the discussion.					
4. This activity helped me remove existing dilemmas or stereotypes about STEM careers and encouraged me to further consider choosing a STEM profession.					

Open-ended questions

1. What did you like the most in this activity?

2. **What would you like to do differently in this activity?**

9. APPENDIX 2. Adults' participants' questionnaire

The purpose of the questionnaire is:

- For adults to evaluate the different type of activities in which they participate.

Explaining the logic:

- We tried to keep the questionnaire short because some of the activities are short as well. We will collect more information with the case studies, especially for the teachers.
- The questionnaire is the same for all adult participants.

Adults' questionnaire

[Please provide the evaluation moment: pre-test ☐ post-test ☐]

[Please provide the name of the activity]:

Partner(s) involved in designing the activity

[Please provide the name of the partner(s) involved in the activity]:

[Please add the date]:

Part A. Background information

Gender:
Age:
Educational level:
Profession:

Type of activity you are attending: (you can check only one):

Lighthouse activity ☐ Open schooling activity ☐ Interactive career talks ☐

Part B. Evaluation of activity

Please indicate your level of agreement or disagreement on the following statements using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree" (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree)					
Statements	**1**	**2**	**3**	**4**	**5**

1. Was enjoyable					
2. Helped me learn new concepts					
3. Helped me to understand the connection of science to everyday life					
4. The activity helped me understand the importance of cooperation between community and scientists					
5. Required to interact with other participants (students, scientists, people from the industry).					

10. APPENDIX 3. Teachers' initial interview for OS

The purpose of the teachers initial interview is:

- To obtain general information about their usual teaching practices and what they expect from their participation in the open schooling activity.

Explaining the logic:

- The intention is to be able to contrast this information with that obtained later in the retrospective interview.
- The reason for not conducting this initial interview as exhaustively as the retrospective interview is not to increase the fatigue of the participating teachers, who have to fill in several questionnaires, carry out the open schooling activity and, in some cases, also conduct the retrospective interview.

Duration:

- The length of the initial interview is intended to be between 15 and 30 minutes, it depends on the depth with which teachers answer the questions.

Teachers' initial interview

[Please provide the name of the activity]:

Partner(s) involved in designing the activity

[Please provide the name of the partner(s) involved in the activity]**:**

[Please add the date]:

Part A. Background information

Code Name: … … … … [the initial of your name/the number of the day you were born (i.e. if it was July 15 write 15)/the initial of your mother's name]
Gender:
Age:
Educational level:
Speciality (e. g. Biology, Physics, etc):
Years of service:

Part B. Questions

1. **Have you ever participated in an open school or similar activity?**
   With similar activities we mean activities with collaborations with other partners, working on real-life contexts or for the wellbeing of the community. IF YES, can you describe (briefly) the activity (topic, place, duration, educational goals, and difficulties found)?

2. **How would you define your classes in terms of approaches, methodologies, contents, resources, contextualization, etc.**

You can comment on questions such as whether your classes are usually expository or participative, whether you stick to textbook content or use other sources, whether you focus on teaching content or also procedures and/or attitudes, whether you usually deal with current/media/conflictive issues in the classroom, whether you collaborate with other people - such as other teachers, professionals, disseminators, associations, administrations, etc. - for one or more of your classes, etc.

3. **What do you expect from your participation in the open schooling activity?**
   You can comment on questions such as whether you expect students to be more engaged than they usually are in class or not, whether you think they will be more focused/motivated/interested or less than usual, whether you think it can help you as a teacher and, if so, which ones, whether you think this kind of activity can help you to handle some problems you usually encounter in the classroom and, if so, which ones - if you have had to deal with problems related to gender issues, please comment on them -, whether you expect to have to spend more time on this activity than on other activities you usually do in class, how you think your school, workmates and parents will receive the activity, etc.

5.1 Teachers' retrospective interview

The purpose of the teachers' retrospective interview is:

- for teachers to evaluate their perceptions about the open schooling activities, as a framework for the case studies.

Explaining the logic:

- As it said in the project document: "The retrospective interviews with teachers will contain questions such as the value of open schooling, impact on students and community, the willingness of continuing with open schooling, support needed for open schooling and so on. We deliberately choose an interview with teachers to get a more in-depth insight on open schooling.". For these reasons, we have organised the questions based on these 4 aspects: value of open schooling, impact on students and community, willingness of continuing with open schooling and support needed for open schooling. We also consider it necessary to include questions about: influence of the previous activities (interactive career talks and lighthouse activities) in the open schooling activity and gender issues.
- Part A is the same as in the questionnaires, although new questions on years of service and specialization have been included.
- The code name is indented to link questionnaires with interviews.

Duration:

- The length of the retrospective interview is intended to be around 1 hour.

Teachers' retrospective interview

[Please provide the name of the activity]:

Partner(s) involved in designing the activity

[Please provide the name of the partner(s) involved in the activity]**:**

[Please add the date]:

Part A. Background information

Code Name: … … … … [the initial of your name/the number of the day you were born (i.e. if it was July 15 write 15)/the initial of your mother's name]
Gender:
Age:
Educational level:
Specialization:
Years of service:

Part B. Value of open schooling

1. **What do you consider as the most valuable aspect of open schooling activities for you as a teacher, for the students, for the parents and for the rest of the community?**

Supporting information (SI) for interviewers:

You can comment on the most valuable insight you/students/parents/community have gained, whether the experience affected your personal/professional development, whether you have noticed any changes in your teaching approach after your participation in the program, whether

you and/or your students were able to make connections between the community problems and the curriculum, whether the open schooling activity helped to identify and address the local problems of the community, etc.

2. **How do you consider the relationship between the school, the parents and the rest of the community during the participation in the open schooling activity?**

SI for interviewers:

You can comment on what do you consider as the most valuable effects on the relationships between the school, the parents and the rest of the community during the participation in the open schooling activity, whether you would highlight any negative aspects, in which group did you perceive the greatest participation during the activity (parents, scientists/professionals/other members of the community), what kind of synergies or relationships have been established (e.g. collaboration between parents and other members of the community), etc.

Part C. Impact on students and community

Impact on students

3. **Can you give examples of how participation in the open schooling activity did affect students' scientific skills/competences?**

SI for interviewers:

You can comment on whether the participation influenced students' learning of scientific content knowledge, whether the participation influenced students' learning of scientific practices/procedures (for example, ask questions, hypothesise, collect and analyse data, use scientific concepts in real life problems, etc.), whether you feel that the open schooling activity has helped students learn about the relevance of science to real-life challenges, whether you think the activity has been able to strengthen the students' understanding of and confidence in science as a means of solving problems in modern society, whether open schooling is a way of giving prominence to scientific literacy/life-long learning, etc.

4. **Can you give examples of participation in the open schooling activity did affect students' motivation/active participation and self-confidence?**

SI for interviewers:

You can comment on whether you think that parental involvement has been a motivating factor for students, whether you think that dealing with local community problems has been a motivating factor for students, whether you think that the challenge of facing and having to propose solutions to local community problems has been a motivating factor for students, whether the students receive feedback from the local population, and if they received it, how did they feel about it, etc.

Impact on community

5. **Give examples has the open schooling activity had an impact on the community (others than school community)?**

SI for interviewers:

You can comment on whether you think the activity has contributed to the scientific literacy (learning of scientific concepts/practices) of the local adult population, whther you feel that the open schooling activity has helped local people learn about the relevance of science to real-life challenges, whether you think the activity has been able to strengthen the local population's understanding of and confidence in science as a means of solving problems in modern society, whether you perceived interest from the local population in the solution proposed by the students, whether you perceived interest from other teachers and/or stakeholders to participate in open schooling activities and, if you reveiced it, in which ways were they interested, whether you knew about other teachers interested or thinking about participating in/carrying out open schooling activities in the future, etc.

Part D. Willingness of continuing with open schooling

6. **After your participation in the project, do you plan to continue developing open schooling activities in the future? Explain why.**

SI for interviewers:

You can comment on what kind of support would you ask for in the future to carry out an open schooling activity, whether you would consider the formation of a collaborative network of teachers to be useful for the further implementation of open schooling activities, etc.

Part E. Support needed for open schooling

7. **How was the support received from the project to carry out the open schooling activity?**

SI for interviewers:

You can comment on what difficulties have you encountered when designing and implementing the open schooling activity, what was the usefulness of the support packages, the different stakeholders (mentors, Science Education Institutes/local coordinators/Science Research Institutes/Community Institutions/Community institutions/enterprises) and/or the lab equipment resources for designing and developing the open schooling activity, what differences you find between previous experiences and this one (in case you had participated in other open schooling or similar activities before participating in this project), etc.

8. **Apart from the project, have you received support, or encountered obstacles, from your work environment?**

SI for interviewers:

You can comment on how did you perceive the role of your school/colleagues in your participation in the program (support or obstacle), whether you think there is something to be changed in the common teachers' practices to support integration of open schooling approaches, whether the curriculum can be considered as compatible to support the changes required for developing open schooling activities, etc.

Part F. Gender Issues

9. Have you encountered gender differences during the implementation of the open school activity? Explain them.

SI for interviewers:

You can comment on whether you found differences between boys and girls during the open schooling activity (interest, motivation, active participation, topics proposed, decision-making processes), whether you found differences in girls' performance in the open schooling activity compared to more traditional activities, whether you think that open schooling activity has helped you to manage these differences (if any), whether you highlight any issues in relation to the way boys work during the activity, whether you found any differences with respect to their usual way of working in class, whether you found any differences in the relationships girls and boys establish when working (for example, if they usually mix to work together in class, or do they tend to be grouped by gender), etc.

Part G. Influence of the previous activities in the open schooling activity

10. What, if any, do you consider the interactive career talks and/or lighthouse activity have contributed to the development of the open schooling activity (contributing topics, knowledge, possible problems and/or solutions, etc.)?

SI for interviewers:

You can comment on whether you think that the interactive career talks and/or the lighthouse activity have influenced the students during the open schooling activity (contributing topics, knowledge, procedures, possible problems and/or solutions, etc.), whether the interactive career talks and the lighthouse activity as a teacher helped you to lead the open schooling activity, etc.

11. APPENDIX 4. Students' focus group for Open Schooling Activities

The purpose of the students' focus group is:

- for students to express their perceptions about the open schooling activities after their participation.

Explaining the logic:

- The idea of this focus group is to be able to compare the information provided by the teachers in the retrospective interviews with that provided by the students after participating in the activity, in order to contrast both perceptions. The focus group is a way to support, or not, the teachers' perceptions, as evidence to support, or not, the information provided by teachers.
- We recommend conducting the focus group with the students after the retrospective interview with the teachers, in case any modifications need to be made to the focus group to allow us to obtain the necessary information to contrast both sources (teachers and students).
- We have organised the questions based on the same aspects as in the teachers retrospective interviews.
- Part A is only the code name. The code name is indented to link questionnaires with the participants in the focus group.

Duration:

- The length of the focus group is intended to be around 1 hour.

Students' focus group

[Please provide the name of the activity]:

Partner(s) involved in designing the activity

[Please provide the name of the partner(s) involved in the activity]**:**

[Please add the date]:

Part A. Background information

Participants:

Participant 1. Code Name: …… [the initial of their name/the number of the day they were born (i.e. if it was July 15 write 15)/the initial of their mother's name]
Participant 2. Code Name: ……
Participant 3. Code Name: ……
Participant 4. Code Name: ……
Participant 5. Code Name: ……
Participant X. Code Name: ……
……

Part B. Value of open schooling

1. **What is your overall assessment of your participation in the open schooling activity (positive, negative)?**

Supporting information (SI) for interviewers:

You can comment on what you would highlight that you have learned during the activity, what have you done differently from what you usually do in other classroom activities, whether you have been able to see connections between the problems in your community and the content you see in class, how did you perceive your parents' participation in the activity (if tey participated), whether you feel that your parents have learned something from participating in the activity (if tey participated), how did you perceive your teacher's work in the activity, whether you noticed anything different in the way he/she worked compared to other activities you normally do in class, whether you think that the members of your community have learned something from the work you have done, whether you think that you have contributed something to solving a problem in your community, etc.

2. **How do you consider the relationship between the school, the parents and the rest of the community during the participation in the open schooling activity?**

SI for interviewers:

You can comment on what has been the best thing about the collaboration between your school, parents and the rest of the community during the participation in the open schooling activity, whether you would highlight any negative aspects, etc.

Part C. Impact on students and community

Impact on students

3. **From your point of view, what have you learnt about science during the open schooling activity (concepts, practices, etc.)?**

SI for interviewers:

You can comment on whether you have learnt new scientific concepts (for example, a word you did not know, a natural phenomenon, things related to environmental problems, etc.), whether you have learnt something new about how scientist/science work/s (for example, ask questions, hypothesise, collect and analyse data, use scientific concepts/models in real life problems, etc.), whether, after participating in the activity, do you think that science is relevant to the problems we face in our daily lives (and if you thought os bafore), whether you feel that you now have a better understanding of science, and do you trust it as a means of solving the problems of modern society (and if you think so before), etc.

4. **How did you feel during your participation in the open school activity?**

SI for interviewers:

You can comment on whether the activity was motivating for you, whether you enjoyed participating in the open school activity more than other activities you normally do in class, whether you tried to be actively involved in the activity, whether you offered to participate in as many tasks

as you could, whether there were any tasks in which you were not very motivated, whether you like your parents' participation in the activity (if they participated), what was it like to have to deal with a real problem in your community, what positive/negative aspects would you highlight from working with a real problem in your community, whether you received feedback from your community about your project and, if so, what did they think of it, etc.

Impact on community

5. **From your point of view, do you think your project has had an impact on your community?**

SI for interviewers:

You can comment on whether you think the activity has contributed to members of your community (apart from students, teachers, parents) learning about science (science concepts/practices), whether you think the activity has helped your community to learn about the relevance of science to real problems in our daily lives, whether you think your activity has helped your community to understand and trust science more as a means to solve real problems in our daily lives, how did you perceive the interest of the local population in the solution you proposed in the project, etc.

Part D. Willingness of continuing with open schooling

6. **Following your participation in the activity, would you like to participate in open schooling or similar activities again in the future?**

SI for interviewers:

You can comment on what you would change if you were to participate in an open school activity or similar in the future, whether you have missed any kind of help or resources to develop the activity, etc.

Part E. Support needed for open schooling

7. **How was the support received from the project to carry out the open schooling activity?**

SI for interviewers:

You can comment on w**hat difficulties have you encountered during the open schooling activity, how did you perceive the help given by the other participants (teachers, parents, scientists, professionals, etc.), whether the materials and resources (e.g., laboratory equipment) were helpful during the activity, whether you found any differences between this one and others you have participated in before, etc.**

8. **Did you receive support other than from your teacher, parents and scientists/professionals?**

SI for interviewers:

You can comment on whether you received support from your school to develop the activity, whether you have encountered any obstacles at school, whether other teachers collaborated, what was the opinion of the other teachers about your participation in the activity and if they helped you or did you encounter any obstacles, what do you think should change in the school in order to be able to develop more open school activities, etc.

Part F. Gender Issues

9. Do you think there has been any difference in the participation of girls and boys during the open school activity?

SI for interviewers:

You can comment on whether you noticed any differences between your classmates, boys and girls, during the open schooling activity (interests, participation, topics proposed, way of working), whether you experienced any conflicts or situations to be resolved that you consider to be gender-related (for example, different tasks were assigned to boys and girls without taking into account your preferences, it was assumed that girls or boys could not do a certain task, etc.), who do you think participated more actively in the activity, the girls or the boys? Whether you noticed any differences in the participation of girls and boys compared to other more traditional activities that you do in class (for example, girls or boys tend to participate more in class and in the open schooling activity it was the other way around), whether, during the open schooling activity, you worked in mixed groups (girls and boys), etc.

Part G. Influence of the previous activities in the open schooling activity

10. Do you consider that the interactive career talks and/or the lighthouse activity have helped you in the development of the open schooling activity (input of issues, knowledge, possible problems and/or solutions, etc.)?

SI for interviewers:

You can comment on whether the interactive career talks and/or the lighthouse activity have been useful in developing the open schooling activity, whether they help you to propose/choose topics/problems/solutions, whether you use now concepts/procedures/approaches you have seen in those activities during the open schooling activities, etc.

12. Appendix 5. Observation template for lighthouse activities

The purpose of gathering data following the "Observation Template" is to support the evaluation of the lighthouse activities conducted during the pilot phase of the project and, consequently, facilitate their future improvement. Additionally, the collected data will be valuable in illustrating international best practices.

The focus of this observation is on both the participants and the activities themselves. Specifically, dimensions A (Conceptual knowledge), B (Skills), and C (Difficulties experienced), described below, are intended to collect data on the conceptual knowledge and skills that participants develop during the implementation of the lighthouse activity. Dimensions D (Relevance), E (Consistency), F (Practicality), and G (Activity effectiveness), on the other hand, aim to gather data on the relevance, consistency, practicality, and effectiveness of the activities.

Next, a template intended to serve as the reference document for the observation of the lighthouse activities implementation is presented.

Observation Template

[Please provide the name of the Lighthouse activity]:

[Please provide the name of the observer]:

Date:
Local:
Partners involved:
Target group:
Number of participants:

A. Conceptual knowledge

The activity promotes the development of conceptual knowledge

Theme	Field notes
Environmental issues - Green Deal	
Digitalization	
Health	

B. Skills

The activity promotes the development of skills.

Skills	Field notes
Attitudes	
Skill in mobilising knowledge	
Communication skills	
Creativity	
Formulating hypotheses	
Appropriate use of technology in solving the problem/challenge	
High order thinking skills (decomposition; abstraction; pattern recognition; error detection; ...)	
Critical thinking skills	

C. Experienced difficulties

The participants experienced difficulties.

Difficulties	Field notes
Overall level of difficulty	
Application of concepts	
Specific actions / processes	
Understanding of the problem / challenge	
Create or identify a valid solution to the problem / challenge	

D. Relevance

The activity is relevant.

Relevance	Field notes
Relevance of the activity according to its objectives	
Applicability of mobilised knowledge to real-life contexts	
Engagement of the participants in the activity (active participation, questions asked, and discussions generated)	
The different subjects are considered and well articulated in the implementation of the activity.	
The activity in its implementation promotes collaborative	

work between participants.	

E. Consistency

The activity is logically designed.

Consistency	Field notes
Clarity of procedures	
Coherence with the objectives to be achieved	
The activity follows a logical and coherent flow with stages well connected.	
Adequacy of resources, support and instructions	
Time allocated for the activity is adequate	

F. Practicality

The activity is usable in the settings for which it has been designed.

Practicality	Field notes
Allows areas of knowledge to be integrated and mobilized	
Enables the application of competences / skills	
Accessibility of resources	
Time needed to carry out the activity	
Adequate Complexity	
Suitability of space	
Cost	
The activity can be adapted to different contexts or groups of participants	

G. Activity effectiveness

Using the activity results in the desired outcomes.

Effectiveness	Field notes
The activity is aligned with the specific objectives it aims to achieve.	
The activity is implemented consistently and according to	

the initial planning.	
The activity intervention has a long-term impact on the participants. The effects last beyond the activity itself.	
Participants' satisfaction with the activity	

7.
8.
8.3
8.4
8.5
8.6
12.1
12.2
12.3
12.4
12.5
12.6