

Final Evaluation of the impact of the MOST project D8.1

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Content

Executive Summary.....	3
Main Report.....	5
1. The MOST evaluation concept.....	5
2. Research questions.....	6
3. Development of the MOST student questionnaire	6
4. Development of the MOST teacher questionnaire.....	7
5. Participants in the MOST case studies	7
6. General guidelines for conducting a semi-structured interview	9
7. Information letter for parents/guardians	11
8. Parents or Guardians' consent form.....	12
9. Form to collect the background information from the students participating in the group interview	13
10. Form to collect the background information from the teacher/s participating in the stakeholder group interview	16
11. Form to collect the background information from the school leader participating in the stakeholders' group interview.....	18
12. Form to collect the background information from the MOST advisor participating in the stakeholder group interview	20
13. Student group interview.....	22
14. Stakeholders' group interview.....	23
15. Template for the report of the MOST case studies.....	24
16. Student pre-questionnaire	27
17. Student post-questionnaire	32
18. Teacher post-questionnaire.....	38
19. Validity and Reliability of the MOST questionnaires	42
20. Qualitative analysis of regional case studies.....	43
21. Main results from the evaluation of the impact of SCP on students.....	44
22. Transnational case study analysis after a validation workshop	62
23. What are the characteristics of good SCP and the main barriers for a successful implementation?	62
24. How are SCP perceived by participants and what are the main learning outcomes?	66
25. Final remarks.....	68
26. Other supporting bibliography.....	69

Executive Summary

This report constitutes the main deliverable of WP8 responsible for the project evaluation. This work package has three specific objectives: i) To evaluate the extent to which the project has reached its general and specific aims. ii) To evaluate the short-term project impact. iii) To evaluate the SCPs from a systemic perspective (what went well and what did not), to give advice on how to run such projects. Based on that, the present report includes two main contributions from WP8: 1) The development of the evaluation concept and its related framework, as well as the set of tools and templates for data collection and reporting. 2) The main results obtained after applying the previously described evaluation framework and a brief discussion of how these results provide research evidence to respond to the overarching evaluation questions. In the following paragraphs we summarize the two main contributions included in this report:

The main aim of the MOST evaluation concept was to provide a research design and a collection of evaluation instruments that fulfil the purpose of the project evaluation. The project evaluation had a twofold purpose: on one hand it intended to measure the project's short-term impact in terms of the promotion of science literacy, perceived relevance and positive attitudes towards science and scientific careers, as well as increased sustainability awareness and individual capacity to act on environmental issues. On the other hand, it should provide a collection of multiple case studies from ten European countries, illustrating how School Community Projects (SCP) may be articulated to adapt to different regional contexts, as well as barriers and supportive aspects for their successful and productive implementation. As a consequence of the participatory development of the evaluation concept, a collection of research questions and evaluation instruments was provided. The collection of evaluation instruments included a template for reporting on case studies, questionnaires for the main participants (students and teachers) used either as pre/post instruments (student questionnaire) or just post instruments (teacher questionnaire), along with guidelines and basic questions for the semi-structured interviews of a wide range of stakeholders using focus group discussions (teachers, students, school leaders, MOST advisors, family members as well as representative from the scientific community, business or policy sectors).

In relation to the object of evaluation, we should state that all the SCP run across the consortium from 2020 till May 2023, shared a common way of engaging community members following the *Manual to plan and perform SCP* described in D3.1. In addition, all of them adopted the pedagogical foundation described in D4.2 *Pedagogical guidelines and exemplary science materials*, where illustrating solutions and materials have been published. However due to the wide variety of SCP conducted in the ten partner countries and their differences concerning the age of the participating students, the socio-cultural context in which the projects were embedded and their duration in time, among other circumstances, we decided to develop closer looks based on the analysis of regional case studies. Furthermore, following the European Support Team's (EST) recommendations for a scientifically rigorous report, the quantitative evaluation of the impact of SCP on students' interest in science, scientific literacy and sustainability of consciousness was made in a selective way, focusing on paired pre/post data belonging to particular SCP, in order to take into consideration the influence of contextual factors.

On a general level, quantitative data from the pre/post evaluation of different SCP show positive effects on students' science literacy, perceived relevance and positive attitudes towards science and scientific careers, as well as an increased understanding of sustainability problems related to waste and energy management and enhanced awareness of their personal role in solving them. However, the magnitude of these effects and the gain patterns depend on the characteristics of the SCP and the socio-cultural contexts where it was implemented.

To better understand how these contextual factors affect the consequent outcomes, we run a qualitative analysis of the collection of regional case studies. The main aim was to look at how SCP were experienced by participants and finally, what were the key features of good SCP and the main barriers for a successful implementation. Regarding the first question, the content analysis of participants' quotations revealed a predominance of feelings of proud and enjoyment and a sense of relevance and impact of what has been achieved. In relation to the characteristics of good SCP, the qualitative analysis shows the importance of planning in advance and getting the school and community support, as well as linking the project to both local problems relevant to those involved and the school curriculum. Participants also expressed a desire to share and disseminate results, to keep on working in this way and to do more about the issues approached in a near future. Regarding the main barriers for a good implementation, teachers usually refer to lack of time or experience, a rigid school curriculum and organization and sometimes, difficulties to collaborate with other colleagues and engage external agents. They require recognition to their efforts and bigger support and flexibility to run such projects.

In relation to students' learning outcomes, the complementary qualitative analysis of teachers', students' and parents' perceptions provide nice evidence about how SCP offered meaningful contexts to apply mathematics and science content knowledge and skills to solve relevant local problems, and to what extent these kind of projects make students develop interesting transdisciplinary skills related to teamwork, communication, creativity, and critical thinking. Finally, participants' quotations illustrate how those experiences help students understand the basis of some sustainability problems and make them to engage in active mitigation actions or the search for solutions.

Main Report

1. The MOST evaluation concept

The evaluation concept has been developed based on the description of work and the feedback received from the consortium as a whole, in the first project meeting, as well as from specific partners acting as expert reviewers (especially from WARA and SFR, but also experts from NTNU, UOM, CUNI and UU).

As a consequence of the participatory development of the evaluation concept, a collection of research questions and evaluation instruments has been provided.

Due to the scope and ambition of the evaluation concept, a mix methods approach is used combining quantitative and qualitative methods. Mix methods allow researchers to obtain a richer picture, combining the strengths of quantitative and qualitative approaches and overcoming their particular weaknesses (Creswell, Plano, & Clark, 2011; Yin, 2009).

We have developed specific questionnaires for the main target groups (students and teachers) and a template for regional case studies focusing on the key concept behind the MOST project: the development of School Community Projects (SCP) as means to connect school and communities and to provide more authentic, relevant, and meaningful STEM education.

The collection of instruments used to evaluate the short-term impact of the MOST project and to provide a good understanding about how to conduct productive and successful SCP is:

- Student pre/post questionnaire.
- Teacher post-questionnaire.
- Forms to collect background information from the case study participants.
- Semi-structure group interview for students
- Semi-structure group interview for stakeholders
- Template for reporting on the MOST case studies.

According to the description of work, each partner is expected to run a minimum of 60 SCP (20 in the first run and 40 in the second round), involving at least 60 teachers and 600 students per country as a whole. SCP are expected to involve at least 5 school community members each, resulting in 300 community members per country as a whole at the end of the project.

The student questionnaires have been designed to evaluate the impact of the project on students' science literacy, perceived relevance and their attitudes towards science and scientific careers, as well as the impact of the project on participants' awareness with regards to environmental challenges and their role in finding solutions.

The teacher questionnaire includes dimensions related to context-dependency, self-efficacy and expectancy for success, perceived relevance, difficulty, and costs as well as anxiety and enjoyment.

The MOST questionnaires for students and teachers have been developed on the basis of theoretical models from the specialized literature and previously validated instruments. The initial versions of the MOST questionnaires have been submitted to external validation by experts. This report includes the templates used to collect experts' feedback for validity. The internal consistency of the MOST questionnaires is to be measured using statistics methods after piloting.

The template for the case studies includes basic questions and guidelines to provide evidence that support regional case study reports, as well as protocols for the group interview of a wide range of stakeholders (teachers, school leaders, MOST advisor, community members...).

The final collection of case studies from the different participating countries (three case studies per country), would offer a comprehensive European picture illustrating how SCP may be conducted in a wide range of educational context. In addition, case studies would provide a better understanding of how to conduct productive and successful SCP for contributing to a more interested, sustainable, and scientifically literate society and will allow us to develop recommendations for further School-Community-Projects.

In the following sections of the MOST evaluation concept, we include the research questions that guide the evaluation of the project, the collection of instruments and the templates for the expert validation of the student and teacher questionnaires.

2. Research questions

The following research questions frame the evaluation of the MOST project:

1. What are the characteristics of good SCPs and the main barriers for a successful implementation and networking?
2. How do participants perceive and experience SCP?
3. How do SCPs affect students' attitudes and beliefs about science, scientific careers and the relevance of science and science education for their lives? Are there gender differences?
4. How do SCPs affect science literacy and participants' awareness with regards to environmental challenges and their role in finding solutions? Are there gender differences?

3. Development of the MOST student questionnaire

The MOST student questionnaire is an evaluation instrument to be administrated before and after students' participation in the MOST project, that intends to measure the project impact on the participating students.

Items have been formulated based on previously existing and validated instruments in the specialized literature and have been slightly adapted to better fit the project characteristics and purposes. In those cases, where no existing instruments were available, items have been developed based on theoretical models and experts' definition (this is the case for items in the science literacy dimension).

Items are grouped in different dimensions. The following dimensions have been considered:

- Perceived relevance
- Interest and enjoyment
- Self-efficacy

- Science literacy
- Intention to study a scientific career
- Sustainability knowledge
- Sustainability attitudes
- Sustainability behaviors

The MOST student evaluation questionnaire is available in annex I. It has been submitted to the evaluation of its content validity by experts according to the template available in annex II.

4. Development of the MOST teacher questionnaire

The MOST teacher questionnaire is an evaluation instrument to be administered after teachers' participation in the MOST project, that intends to evaluate how the participant teachers have perceived the experience in terms of its relevance for students' learning, difficulty for implementing SCP and cost in daily teaching. Furthermore, the questionnaire incorporates items that evaluate how teachers perceived themselves when implementing SCP in terms of self-efficacy and expectancies for success. In addition, some items have been introduced to measure teachers' enjoyment and anxiety along with questions that intend to collect information about how the teaching and learning context has influenced the teachers' attitude to implement innovation.

Items have been formulated based on previously existing and validated instruments in the specialized literature and have been slightly adapted to better fit the project characteristics and purposes.

Items are grouped in different dimensions. The following dimensions have been considered:

- Perceived relevance
- Perceived difficulty and "cost"
- Enjoyment/Anxiety
- Self-efficacy
- Expectancy for success
- Context dependency

5. Participants in the MOST case studies

Any partner should provide 3 case studies illustrating how SCP have been conducted in their own national/regional context. To develop an in-depth view of how SCP have been perceived and experienced by different participants and the key aspects influencing the whole process and its outcomes, it is recommended to involve different stakeholders, including not only the main actors (students and teachers), but also any other people playing a key role in the development of the SCP (MOST advisors, school leaders, community members...).

Group interviews have been chosen as the best instruments to catch different perspectives while fostering discussion and exchange and optimizing time and resources.

According to the arguments provided above, any case study should include at least **two group interviews**: a students' group interview and a stakeholders' group interview:

The **students' group interview** should involve 3-5 students. You should select students on the basis of their role in the SCP and capacity to represent different types of students, according to their level of interest and engagement.

The **stakeholders' group interview** should involve at least 1 teacher, 1 school leader, 1 MOST advisor and 2 community members (who can represent parents, professionals from different fields, policy makers, etc.).

Participants in case studies are chosen purposefully in order to support a better understanding of all the key issues related to the development of SCP. In this respect, it is important to explain how you have chosen the participants in your MOST case studies.

Description of participants in the case study

Describe their main characteristics and background. You can use your own knowledge about participants, their personal introduction before the group interview and the information collected through the initial form (see the form to collect participants' background information).

Participant n°	Underline the type of participant: Student, teacher, school leader, MOST advisor or community member.
Age	
Gender	
Pseudonym	
Why did you choose he/her	
Relevant background information	

Participant n°	Underline the type of participant: Student, teacher, school leader, MOST advisor or community member.
Age	
Gender	
Pseudonym	
Why did you choose he/her	
Relevant background information	

....

Insert as many tables as participants you have in your case study.

6. General guidelines for conducting a semi-structured interview¹

These general guidelines are applicable to any of the group interviews conducted for the MOST case studies.

Initial recommendations

- Get familiar with the interview guidelines provided. If possible, practice the interview in advance.
- Translate the interview guidelines into your language, being careful about the wording of the questions.
- Think of possible phrases that support the transition between the different questions.

Preparing the interviews

- Choose a place for the group interview that is quiet and free from interruptions.
- Test the recording system.
- Record the interview and transcript it afterwards. Merely taking notes brings some risk of missing important information.
- Begin with an explanation of the purpose of the interview; intended uses of the information and assurance of confidentiality (see interview guideline). If appropriate, clarify that the interview has been approved by relevant officials.
- Ask only one question at once. Stay close to the wording you prepared in your interview guide.
- Enjoy the silence.
- Use probing techniques to get a deeper insight. (Would you give me an example? Can you elaborate on that idea? Would you explain that further? I 'm not sure I understand what you' re saying. Is there anything else?)
- Maintain a neutral attitude. Interviewers should avoid giving the impression of having strong views on the subject under discussion.
- Do not put words into participants' mouths. Let them say things in their own words.

¹ These general guidelines are based on MaSDiV interview guide https://icse.eu/wp-content/uploads/2019/03/WP3_Experimentation-protocol_D3.2_Data-collection-instruments-for-case-study.pdf

- Provide feedback and reinforcement during the interview (Your comments on weakness are really helpful. We are about halfway through. You have been telling me really important things. How is it going for you?)
- Maintain control by knowing what you want to find out, by having prepared the interview guide and by listening attentively.

As Patton stated (2002):

“If what people have to say about their world is generally boring to you, then you will never be a great interviewer. Unless you are fascinated by the rich variation in human experience, qualitative interviewing will become drudgery” (p. 341).

Introducing the interview to participants

Here you can find some ideas of how you may introduce yourself and start the conversation with the interviewees:

I want to thank you for allowing us to have this discussion with you today.

My name is _____. I am _____ <if appropriate, short introduction of the interviewer, position in the project>.

It is important to create a nice and relax atmosphere that favors a fluent communication. You might even talk a little about yourself (but remember time is limited). It is important to show interest in the person and to listen carefully.

After thanking them for their participation and introducing yourself, you should ask participants to filled in the form to collect their consent and the background information. After filling in in the initial form, you could invite them to briefly introduce themselves before starting the group interview.

7. Information letter for parents/guardians

Dear Parents/Guardians,

We are a group of researchers from the MOST project. It is a European project involving 23 institutions from 10 European countries, that intends to improve education across Europe through project-based learning. The main idea is to connect science and maths learning to what students need to understand and improve their surroundings. Through their participation in school-community-projects on waste management and energy consumption, students will have the opportunity to understand and apply mathematics and science to solve real world problems, developing interesting competences and getting better prepared for life, while developing a better understanding of current environmental issues and what they can do to improve them.

The MOST research team is responsible for evaluating the potential benefits of the project on the participating students. In order to make it possible, we will need your consent as parents for your son/daughter to take part in the MOST research. Your contribution in this respect, is essential to advance research on how to improve education.

Anonymization and pseudonymization processes will ensure that your son/daughter's real name is not known outside the project or related to the research results and students are free not to participate and to withdraw at any point without justification.

The responses of the questionnaires will be analyzed by an independent research team based at the University of Jaén, Spain. This national team will only be responsible for collecting data from questionnaires, students' work and recordings (audio or video).

We would appreciate having your consent by filling the form attached and sending it to school with your son/daughter.

In the case of any difficulty, do not hesitate to contact our national MOST advisor xxxx@xxxx or our Data Protection Officer xxxx@xxxx

Yours faithfully,

Name of the national partners

Contact details of national partners

8. Parents or Guardians' consent form

In order to give your consent, please, tick the appropriate boxes:

I have read and understood the project information letter	<input type="checkbox"/>
I allow my son/daughter to fill in anonymous short questionnaires about the project	<input type="checkbox"/>
I give my consent for my son/daughter to participate in a group interview with audio recording	<input type="checkbox"/>
I allow my son/daughter to be audio recorded for research purposes	<input type="checkbox"/>
I allow my son/daughter to be video recorded in teaching and learning situations for research purposes	<input type="checkbox"/>
I give my consent for the analysis of my son/daughter's work for research purposes	<input type="checkbox"/>
I understand that my son/daughter participation is voluntary, and I can withdraw my consent at any time without having to give any reason for why I no longer want to give my consent	<input type="checkbox"/>
I understand that personal data will not be revealed to people outside the project	<input type="checkbox"/>
I understand that my son/daughter's words maybe quoted in publications, reports, web pages and other research outputs, though never referring to his/her real name.	<input type="checkbox"/>
I agree for the data collected to be archived at specific repositories for research purposes, knowing that data will only being publicly accessed after anonymization and pseudonymization processes.	<input type="checkbox"/>

Name of parent

Signature of parent/guardian

Date

Name of student _____

Your consent is greatly appreciated. Thank you!

9. Form to collect the background information from the students participating in the group interview ²

Dear student,

This interview is part of the evaluation of the MOST project in which you have participated. The main goal of the MOST project is to improve education by connect what is taught at school to what you need to understand the world around you and to improve your surroundings, in collaboration with different people from your community (families, businesses, public institutions, NGO, etc.). In this way, you will have the opportunity to understand and apply mathematics and science to solve real world problems and getting better prepare for life.

The main purpose of this interview is obtaining insight into how you, as participants, have experienced SCP. The interview will take about 55 min. I will be recording the session because I don't want to miss any of your comments.

All responses will be kept confidential. We ensure that any information provided does not identify you as the respondent.

Remember, you don't have to talk about anything you don't want to and you may end the interview at any time. Do you have any questions?

Are you willing to participate in this interview?

I am willing to participate in the interview.

☐ Yes ☐ No

² Distribute this form to any of the participants in the student group interview and give them 5-10 minutes to filled in

The information collected will be used only for research purposes to evaluate the project. We will identify the information provided by you using a personal code, so your personal name is not known.

Please check your answers like this:

☐ ☐ ☒ ☐ ☐ ☐ ☐

Please correct your answers like this:

☐ ☐ ☒ ☐ ☐ ☒ ☐

In order to be able to match the questionnaires you filled in when participating in the SCP and your answers to the interview we will use the following code:

1. first letter of your first name: _____
2. first letter of your mother's first name: _____
3. second letter of your mother's first name: _____
4. Day of your birthday: _____

Now translate your code:

1. Check the first letter of your first name.																														
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z					
2. Check the first letter of your mother's first name.																														
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z					
3. Check the second letter of your mother's first name.																														
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z					
4. Check the day of your birthday.																														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Please enter today's date

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What year were you born in? (e.g. 2005)

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Are you female or male?

☐ female

☐ male

Initial questions for the participants in the student group interview:

You can provide them in advance to let participants enough time to respond to them in a written way, or just distribute them some minutes before starting the interview. You can even consider discussing them orally if you have favorable conditions for that:

1. What is your favorite school subject?
2. Which subject do find the most difficult at school?
3. What subject do you like the least at school?
4. Do you consider yourself as a good, bad or medium student at school? Why?
5. What do you like to do in your free time?
6. Did you enjoy taking part in the SCP? Why?
7. What did you like most in the school community projects?
8. What did you like less in the school community projects?

10. Form to collect the background information from the teacher/s participating in the stakeholder group interview ³

Dear teacher,

This interview is part of the evaluation of the MOST project in which you have participated. As you know, the MOST project is an international initiative involving 23 institutions from 10 European countries that collaborate to improve STEM education through project-based learning. The main idea is to connect what is taught at school to what your students need to understand and improve their surroundings, in collaboration with different people from their community (families, businesses, public institutions, NGO, etc.). In this way, they will have the opportunity to understand and apply mathematics and science to solve real world problems, developing interesting competences and getting better prepare for life.

The aim of this interview is obtaining insight into how you, as participants, have experienced SCP. The interview will take about 55 min. I will be recording the session because I don't want to miss any of your comments.

All responses will be kept confidential. We ensure that any information provided does not identify you as the respondent.

Finally, we will transcribe the whole interview and send you the transcript to ask for approval.

After analyzing the information, we will produce a national report. Finally, an international report to the European commission will be delivered at the end of the project including recommendations on how to conduct SCP to improve STEM education across Europe. I will be happy to send you both reports if you are interested.

Remember, you don't have to talk about anything you don't want to, and you may end the interview at any time. Do you have any questions?

Are you willing to participate in this interview?

I am willing to participate in the interview.

Name

Signature

Date

³ Distribute this form to the teacher/s participating in the stakeholders' group interview and give them 5-10 minutes to filled in

Please enter today's date

--	--	--

What year were you born in? (e.g., 2005)

Are you female or male?

☐ female

☐ male

Initial questions

You can provide them in advance to let participants enough time to respond to them in a written way, or just distribute them some minutes before starting the interview. You can even consider discussing them orally if you have favorable conditions for that:

1. Why did you decide to become a teacher?
2. What are your most important goals as a teacher?
3. For how many years have you been a teacher?
4. How long have you been teaching at this school?
5. How would you describe your school?
6. How many teachers and students are there?
7. What are the main challenges in your school?
8. How would you describe the diversity in your school?
9. How did you know about the project and SCP?
10. Why did you decide to participate?
11. How was the structure of the teamwork in the SCP?
12. Were the materials provided by the consortium useful?
13. Was there something you needed, and you did not get?

11. Form to collect the background information from the school leader participating in the stakeholders' group interview ⁴

Dear participant,

This interview is part of the evaluation of the MOST project in which you have participated. As you know, the MOST project is an international initiative involving 23 institutions from 10 European countries that collaborate to improve STEM education through project-based learning. The main idea is to connect what is taught at school to what your students need to understand and improve their surroundings, in collaboration with different people from their community (families, businesses, public institutions, NGO, etc.). In this way, they will have the opportunity to understand and apply mathematics and science to solve real world problems, developing interesting competences and getting better prepare for life.

The aim of this interview is obtaining insight into how you, as participants, have experienced SCP. The interview will take about 55 min. I will be recording the session because I don't want to miss any of your comments.

All responses will be kept confidential. We ensure that any information provided does not identify you as the respondent.

Finally, we will transcribe the whole interview and send you the transcript to ask for approval.

After analyzing the information, we will produce a national report. Finally, an international report to the European commission will be delivered at the end of the project including recommendations on how to conduct SCP to improve STEM education across Europe. I will be happy to send you both reports, if you are interested.

Remember, you don't have to talk about anything you don't want to and you may end the interview at any time. Do you have any questions?

Are you willing to participate in this interview?

I am willing to participate in the interview.

Name

Signature

Date

⁴ Distribute this form to the teacher/s participating in the stakeholders' group interview and give them 5-10 minutes to filled in

Please enter today's date

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What year were you born in? (e.g., 2005)

Are you female or male?

☐ female

☐ male

Initial questions

You can provide them in advance to let participants enough time to respond to them in a written way, or just distribute them some minutes before starting the interview. You can even consider discussing them orally if you have favorable conditions for that:

1. For how long have you taken this position?
2. What are your most important goals as a school leader?
3. What is your background?
4. How would you describe your school?
5. How many teachers and students are there?
6. What are the main challenges in you school?
7. How would you describe the diversity in your school?
8. How did you know about the project and SCP?
9. Why did you decide to participate?

12. Form to collect the background information from the MOST advisor participating in the stakeholder group interview ⁵

Dear participant,

This interview is part of the evaluation of the MOST project in which you have participated. As you know, the MOST project is an international initiative involving 23 institutions from 10 European countries that collaborate to improve STEM education through project-based learning. The main idea is to connect what is taught at school to what your students need to understand and improve their surroundings, in collaboration with different people from their community (families, businesses, public institutions, NGO, etc.). In this way, they will have the opportunity to understand and apply mathematics and science to solve real world problems, developing interesting competences and getting better prepare for life.

The aim of this interview is obtaining insight into how you, as participants, have experienced SCP. The interview will take about 55 min. I will be recording the session because I don't want to miss any of your comments.

All responses will be kept confidential. We ensure that any information provided does not identify you as the respondent.

Finally, we will transcribe the whole interview and send you the transcript to ask for approval.

After analyzing the information, we will produce a national report. Finally, an international report to the European commission will be delivered at the end of the project including recommendations on how to conduct SCP to improve STEM education across Europe. I will be happy to send you both reports if you are interested.

Remember, you don't have to talk about anything you don't want to and you may end the interview at any time. Do you have any questions?

Are you willing to participate in this interview?

I am willing to participate in the interview.

Name

Signature

Date

⁵ Distribute this form to the teacher/s participating in the stakeholders' group interview and give them 5-10 minutes to filled in.

Please enter today's date

--	--	--

What year were you born in? (e.g., 2005)

--

Are you female or male?

☐ female

☐ male

Initial questions

You can provide them in advance to let participants enough time to respond to them in a written way, or just distribute them some minutes before starting the interview. You can even consider discussing them orally if you have favorable conditions for that:

1. What is your background?
2. How did you know about the project and SCP?
3. Why did you decide to participate?
4. How was the structure of the teamwork in the SCP?
5. Were the materials provided by the consortium useful?
6. Was there something you needed, and you did not get?

13. Student group interview

Before the group interview

Read the general guidelines about how to prepare the group interview and how to create a good atmosphere for communication and exchange. Introduce the project and yourself, thank students for their participation and ask them to fill in the initial form to collect their consent and their background information. After filling in the initial form, you could invite them to briefly introduce themselves before starting the group interview. After the introduction you should start posing the main questions for discussion:

Central questions for the student semi-structure group interview

9. How did your SCP start?
10. Who suggested the topic and the questions to be answered by your SCP?
11. Which was the main objective of your SCP?
12. Did you have the opportunity to participate in the organization of the SCP? Were your suggestions taken into account?
13. What kind of information did you need to collect or find out for your SCP? How did you get it? How did you plan and conduct your SCP?
14. How did the teacher support you when participating in the SCP?
15. Were science concepts and ideas important for your SCP? Why? Can you give an example to explain your response?
16. What did you do for your SCP?
17. What did you learn from SCP?
18. In which way the SCP has been important for you?
19. In which way the SCP has been important for your neighbourhood in particular or society in general?
20. In which way the SCP has been important for life in the planet?
21. How did you feel when working in your SCP?
22. What did you find more interesting in your SCP?
23. What did you find more challenging or difficult in your SCP?
24. What did you find more helpful for conducting your SCP?
25. Have your ideas about current environmental/sustainability problems changed after participating in SCP? In which way?
26. Did you miss anything? Is there anything you would have needed for your SCP and you did not get?
27. What would you have done in a different way in your SCP?
28. Would you like your teacher to propose a new SCP again?
29. Would you recommend a friend to participate in SCP?
30. Is there anything else you would like to add?

14. Stakeholders' group interview

Before the group interview

Read the general guidelines about how to prepare the group interview and how to create a good atmosphere for communication and exchange. Introduce the project and yourself, thank attendees for their participation and ask them to fill in the initial form to collect their consent and their background information. After filling in the initial form, you could invite them to briefly introduce themselves before starting the group interview. After the introduction you should start posing the main questions for the group discussion:

Central questions for the stakeholders' group interview

1. How did you know about SCP? How did you get involved in SCP?
2. What was your role in the SCP? What were your contributions to SCP?
3. How did the school support SCP?
4. How did the school collaborate with the community in the development of the project?
5. What were the main difficulties and barriers encountered? How were they faced?
6. From your perspective, what has been the main impact of SCP on students' learning?
7. From your perspective, what has been the main impact of SCP on teachers' professional development and collaboration?
8. From your perspective, what has been the main impact of SCP on the relation between the school and the community?
9. Was there something you needed, and you did not get?
10. Is there something you would do in a different way next time?
11. What are your needs for the future or suggestions for improvement?
12. Will you engage in a new SCP?
13. Would you recommend other colleagues to engage in SCP?
14. Is there anything else you would like to emphasize, comment or share?

15. Template for the report of the MOST case studies

Country:

Number of case study⁶:

Partners are encouraged to draw on evidence to support their reports on the selected case studies. Evidence may come from different sources:

- Observers' notes and reflections.
- Teachers accounts of their experience when implementing SCP.
- Participants questionnaires.
- Participants' group interviews, with responses illustrated by quotations:

Please, illustrate and support your SCP report with evidence that back-up the information provided. Specify the source of information used and provide illustrative quotations, when possible.

Guiding questions	Information	Source/evidence
Describe the characteristics and socio-economic context where the school was embedded.		
Describe the main SCP participants: groups of students, teacher background, out-school participants (community members).		

⁶ 1, 2 or 3 (any country is expected to report 3 case studies)

Guiding questions	Information	Source/evidence
What was the title of the SCP that contextualized the case study?		
How was the topic selected?		
Which questions drove the project and who formulated them?		
How many days/weeks/months took the project?		
How many students were involved? How many of them were girls? Describe them (age group, gender rate).		
How many teachers were involved? How many of them were women? (just in those cases where SCP were addressed on a school-based, i.e., the whole school was involved).		
How did teacher/s implemented and support the SCP?		
How did the school support SCP?		
What was the role of students in the development of the SCP?		
Who from outside school, participated in the school community project as a community member, that is, as a family member or a representative from other sectors		

Guiding questions	Information	Source/evidence
(business, policy...). Describe them: gender, age, profession, role in the project...		
How were the community members chosen and engaged?		
What solutions were proposed to tackled the main problem addressed by the SCP?		
Which were the main contributions of the SCP to the community?		
How was the SCP disseminated and shared?		
Did the SCP participate in the SCP fair?		
What are the characteristics of good SCPs and the main barriers for a successful implementation?		
How do participants perceive and experience SCP?		

16. Student pre-questionnaire

Dear student,

You are going to participate with your teacher and school mates in the European project called MOST: Meaningful Open Schooling Connects Schools To Communities. MOST intends to help you learning mathematics and science in a funny and useful way, while doing School Community Projects (SCP), where you will plan and do activities to solve environmental problems related to waste and energy, using what you learn to improve your community, with other community members.

To know whether the MOST project achieves its main goal, we need to ask you some questions before and after participating in MOST.

Your parents/guardians have already allowed you to participate in this. The information collected through this questionnaire will be shared and used only for research purposes, without putting your name on your responses. So instead of your name, we need a code that you will generate following the instructions provided in the next page.

To generate your personal code, write:

first letter of your first name: _____

first letter of your mother's first name: _____

second letter of your mother's first name: _____

Day of your birthday: _____

Now, transfer your code here:

Mark (cross) the first letter of your first name.																									
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Mark (cross) the first letter of your mother's first name.																									
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Mark (cross) the second letter of your mother's first name.																									
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Mark (cross) the day of your birthday.																									

Please enter today's date

day	month	year

What year were you born in? (e.g., 2005)

Are you female or male? ☐ female ☐ male

Have you ever made projects at school? ☐ YES ☐ NO

Please choose your answers like this: ☒

Please correct, if needed, your answers like this ■

To what extent do you agree?	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
1. I am concerned about how much electric energy we consume at home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I can explain the importance of biodiversity using science ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. My family buys second-hand goods.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I know how I can reduce the amount of plastics we use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I know how to make new items from waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. When solving a scientific problem, I compare and evaluate information to determine what is most relevant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I switch the computer/tablet off if I am not using it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I can explain the effects of the humans' activity on the planet using science ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I care about pollution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I will become a scientist in the future	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. I know how I can reuse or give a second use to my old things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

To what extent do you agree?	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
12. I care about how much waste we produce at home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. I know how to save electric energy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. My family chooses to cycle or walk when we are going somewhere, instead of travelling by motor vehicle.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. I would enjoy working in a science-related career	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. I make actions to improve the environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. I can explain climate change (why the Earth is raising its average temperature) using science ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. I am worried about too many people using polluting cars instead of bicycles or public transports	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. What I learn in science is not useful for my daily life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. What I learn in science can help me in making good decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. When I collect data or find information, I am able to find similarities and differences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. When solving a problem, I try to find relevant information from various resources.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. I will not pursue a science-related study in the future	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. I will study science if I get into college	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

To what extent do you agree?	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
25. I never waste water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. When solving a scientific problem, I try to find patterns in experimental data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. What I learn in science helps me protect the environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. I can explain the importance of energy saving using science ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. I separate food waste before putting out the rubbish when I have the chance.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. I will continue studying science after I leave school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. I know how I can reduce pollution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. What I learn in science classes can help me understand important contemporary issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thank you!

17. Student post-questionnaire

Dear student,

You have participated with your teacher and school mates in the European project called **MOST**: Meaningful Open Schooling Connects Schools To Communities. MOST intends to help you learning mathematics and science in a funny and useful way, while doing School Community Projects (SCP), where you have planned and done activities to solve environmental problems related to waste and energy, using what you learn to improve your community, with other community members.

To know whether the MOST experience was interesting and valuable for you, we need to ask you some questions after participating in MOST.

Your parents/guardians have already allowed you to participate in this. The information collected through this questionnaire will be shared and used only for research purposes, without putting your name on your responses. So instead of your name, we need a code that you will generate following the instructions provided in the next page.

To generate your personal code, write:

5. first letter of your first name: _____
6. first letter of your mother's first name: _____
7. second letter of your mother's first name: _____
8. Day of your birthday: _____

Now, transfer your code here:

5. Mark (cross) the first letter of your first name.																														
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z					
6. Mark (cross) the first letter of your mother's first name.																														
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z					
7. Mark (cross) the second letter of your mother's first name.																														
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z					
8. Mark (cross) the day of your birthday.																														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

	day	month	year
Please enter today's date			

What year were you born in? (e.g. 2005)

Are you female or male? ☐ female ☐ male

Please write here the name of project you have been working (you can ask your teacher)

Please choose your answers like this: ☒

Please correct, if needed, your answers like this ■

To what extent do you agree?	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
1. I am concerned about how much electric energy we consume at home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I can explain the importance of biodiversity using science ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. My family buys second-hand goods.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I know how I can reduce the amount of plastics we use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I know how to make new items from waste	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. When solving a scientific problem, I compare and evaluate information to determine what is most relevant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I switch the computer/tablet off if I am not using it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I can explain the effects of the humans' activity on the planet using science ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I care about pollution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. I will become a scientist in the future	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

To what extent do you agree?	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
11. I know how I can reuse or give a second use to my old things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I care about how much waste we produce at home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. I know how to save electric energy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. My family chooses to cycle or walk when we are going somewhere, instead of travelling by motor vehicle.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. I would enjoy working in a science-related career	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. I make actions to improve the environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. I can explain climate change (why the Earth is raising its average temperature) using science ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. I am worried about too many people using polluting cars instead of bicycles or public transports	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. What I learn in science is not useful for my daily life.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. What I learn in science can help me in making good decisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. When I collect data or find information, I am able to find similarities and differences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. When solving a problem, I try to find relevant information from various resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

To what extent do you agree?	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
23. I will not pursue a science-related study in the future	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. I will study science if I get into college	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. I never waste water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. When solving a scientific problem, I try to find patterns in experimental data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. What I learn in science helps me protect the environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. I can explain the importance of energy saving using science ideas	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. I separate food waste before putting out the rubbish, when I have the chance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. I will continue studying science after I leave school	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. I know how I can reduce pollution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. What I learn in science classes can help me understand important contemporary issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. I find school projects interesting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34. I am sure I can do well in school projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. The activities conducted in school projects are easy for me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

To what extent do you agree?	1 Strongly disagree	2 Disagree	3 Neither agree nor disagree	4 Agree	5 Strongly agree
36. I cannot understand the school projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37. I do not like taking part in school projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38. I make good contributions to school projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39. I enjoy participating in school projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thank you!

18. Teacher post-questionnaire

Dear teacher,

Within the frame of the MOST project, you have been engaged in School Community Projects (SCP). The aim of this survey is knowing how you perceived this experience. Your point of view and help is essential for us to improve future actions and to provide recommendations for the European Commission. The completion of the survey (35 items) will take about 10 minutes. The information collected through this questionnaire will be used and shared anonymously only for research purposes. Be assured that all your answers will be handled confidentially and processed anonymously. All your responses are voluntary.

1. General information

Please write today's date day month

Write the first letter of your first name:

Write the month of your birthday (in number 1-12)

Write the year of your birth (e.g. 1975)

Are you female or male? ☐ female ☐ male ☐ other

Write the country where you teach:

Years of teaching experience (e.g. 12)

Your initial training, background (e.g.: Chemistry, Biology, Sciences, Maths, General Education ...)

Subjects you involved during the SCP implementation (e.g. Science, Maths, Technology...):

SCP ID: Write the title of the SCP you have conducted with your students

2. Your SCP experience

SCP stands for School Community Project and refers to the project you have implemented/worked with students.

Based on your experience after implementing this project, please respond to which extend you agree to the following statements.

Please choose your answers like this: ☒

Please correct, if needed, your answers like this ☐

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. I am confident I did what was expected from me in this SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. I felt nervous while implementing SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I got new input for my teaching.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. I believe I was successful applying SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. I believe that SCP promote students' general development as a citizen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. I think that SCP are useful to make students involved with society's problems.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I think this SCP will encourage my students to choose science careers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. I think that most teachers might find interdisciplinary approaches difficult to be implemented at school.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. I have enough pedagogical knowledge to manage SCP well at school.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. For me, the support of my Principal is decisive for whether or not I will implement SCP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. The SPC helped me enriching my teaching.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. I think that most teachers might find cooperation with community as part of SCP to be difficult to realized.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. I felt tense while implementing SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly agree</i>
14. For me, the support of my colleagues is decisive for whether or not I will implement SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. I learned a lot of new things during the experience with SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. I am able to deal effectively with questions from students related to the work conducted for SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. This SCP experience will be useful for my future work.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. For me, having sufficient knowledge of specific teaching methods (e.g., inquiry-based learning, problem-based learning, etc.) is decisive for whether or not I will implement SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. I was able to effectively put into practice the pedagogical principles of SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. I think that most teachers might find cooperation with colleagues in SCPs difficult to be realized at school.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. I think that the SCP contributed to people's awareness of environmental issues (e.g. energy/waste).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. I have enough content knowledge to teach through SCP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. For me, the availability of supporting teaching materials is an essential prerequisite for being able to conduct SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. The SCP has also promoted my personal learning.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. The SCP gave me the opportunity to collaborate and exchange with other teachers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. I think that most teachers might find SCP to be difficult to implement.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. Teaching through SCP made me anxious	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. I think that SCP must be included in early childhood education	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly agree</i>
29. I think I can succeed in helping students reach a solution during SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. I have a sufficient know-how of SCP to support students effectively in classroom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. I enjoyed implementing SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. I think that the SCP helped us to tackle environmental issues in community.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. I felt enthusiastic using SCP in my teaching practice.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34. From my point of view, having sufficient scientific knowledge is decisive for whether or not I will implement SCP.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Finally:

35. How would you describe your overall experience with SCP	Bad	Poor	Acceptable	Good	Excellent
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thanks for your collaboration!

19. Validity and Reliability of the MOST questionnaires

The process of validation of the pre and post questionnaire to evaluate the impact of school community projects on students' interest in science and scientific careers, their perception of relevance of they learn, their scientific literacy and sustainability consciousness has been described in the following scientific publication:

DEVELOPING TOOLS TO EVALUATE THE IMPACT OF OPEN SCHOOLING ON STUDENTS' SCIENCE LITERACY AND SUSTAINABILITY CONSCIOUSNESS

M. Romero-Ariza, A. Quesada, A.M. Abril, M. Martín-Peciña

Department of Science Education. University of Jaén. Campus Las Lagunillas (SPAIN)

Abstract

This work is part of a European project aimed at improving STEM learning through the development of school community projects as a form of open schooling. School community projects arise from students' concerns and needs and offer interesting opportunities to meaningfully apply science and maths to the solution of locally relevant problems in collaboration with different stakeholders from their community. Within this framework, this paper describes the background, development and validation of a questionnaire to evaluate the impact of school community projects on primary and secondary students' interest in science, scientific literacy and sustainability consciousness.

Keywords: STEM education, education for sustainable development, scientific literacy, sustainability consciousness, open schooling.

1 INTRODUCTION AND AIM

Science and Technology play a crucial role in human capacity to overcome today's planetary problems. Climate change, raw material shortage and the energy crisis are some of the issues questioning contemporary production and consumption models and posing significant challenges to a world that allows unfair big social differences and goes over the Earth's planetary boundaries.

Society needs more than ever well-trained professionals in the STEM (Science Technology Engineering and Mathematics) fields and highly qualified scientists that can significantly contribute to the development of technological solutions to support climate neutral and sustainable cities.

However, pushing scientific and technological advancement is not enough to overcome current societal and environmental problems. Building a more sustainable world requires public engagement, policy measures and regulations and well-informed citizens who feel personally committed to a more sustainable life style. Changing people's consumption habits and behaviours is a big challenge that requires re-shaping personal values and moving from self-enhancement to self-transcendent [1].

Based on the previous considerations, STEM education plays a crucial role to ensure not only highly qualified STEM professionals and scientists, but also STEM literate citizens who can understand current socio-scientific and environmental issues and are prepared to make informed decisions and to take responsible actions. This idea has led to the notion of environmental citizenship, which is at the core of the European Network for Environmental Citizenship (ENEC) <https://enec-cost.eu/>.

According to ENEC, environmental citizens should support healthy relationships with nature, sustainability, and social justice beyond their close circle of relationships and think of the human being as a whole, thereby caring about the prosperity of future generations. To attain these goals, an environmental citizen should be able to critically reflect on the structural causes of sustainability issues and actively engage in the resolution and prevention of problems, exercising their rights and duties and acting accordingly at individual or collective level and in the private or public sphere.

The increasing political interest in environmental citizenship is evident in the European Green Deal, which highlights the key role of citizens in addressing climate change and emphasizes the need to engage pupils, parents, professionals from different fields and the wider community in the changes needed for a successful transition to a green economy and a more sustainable and smarter planet. These transformations entail changes in personal behaviors to reduce carbon and environmental footprints, but also individuals' participation in collective actions to fight climate action and actively contribute to environmental protection [2].

Therefore, education plays a key role in shaping people's values and equipping them with the knowledge and skills necessary to act as informed and responsible citizens. However, critical voices claim that what is taught at schools and high education institutions is far away from what is needed to fully participate

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20. Qualitative analysis of regional case studies

According to the description of the work, any partner country should run 3 regional case studies and report on them, following the guidelines and templates developed to this end and described in some of the previous sections of this report.

The validity and reliability of the results coming from the qualitative analysis was supported considering the criteria for high quality rigorous qualitative analysis stated in the specialized literature (Silverman and Marvasti, 2008⁷). Special attention was paid to the triangulation of results among different sources, various stakeholders, and different types of data.

One important contribution to the triangulation of results was made through the validation workshop conducted with members of the consortium in January 2023 and in May 2023, who had taken an active role in the collection of both, quantitative and qualitative data. During the validation workshop participants from the different partner countries, were asked to build on their own national evaluation data and to provide research evidence to respond to the evaluation questions. Special attention was given to identify the source of the data they were using for the validation and to draw on low inference statements from case study quotations. The main qualitative results presented in this report arise from the participatory validation workshop.

Nevertheless, the richness of the qualitative data collected through the collection of 30 regional case studies will be further exploited for future scientific publications. To this end we are going through iterative cycles of content analysis using the software MAXQDA Analytics Pro 2018 (Release 18.1.1), in order to calculate the interrater reliability Kappa index when engaging different raters.

⁷ Silverman, D., and Marvasti. A. (2008). *Doing qualitative research: A comprehensive guide*. Thousand Oaks, California: Sage Publications.

21. Main results from the evaluation of the impact of SCP on students

Due to the wide variety of SCP conducted in the ten partner countries and their differences concerning the age of the participating students, the socio-cultural context in which the projects were embedded and their duration in time, among other circumstances, we decided to develop closer looks based on the analysis of regional case studies. Furthermore, following the European Support Team's (EST) recommendations for a scientifically rigorous report, the quantitative evaluation of the impact of SCP on students' interest in science, scientific literacy and sustainability of consciousness was made in a selective way, focusing on paired pre/post data belonging to particular SCP, in order to take into consideration the influence of contextual factors.

The data analysis has been conducted through different approaches. Firstly, for those partners with a considerable raw data set, the global analysis of the same was carried out first, to later delve more deeply into the peculiarities of some of the data subsets (we understand by subset, for example, the case of Turkey or Spain where we had considerable data to address this study from both the first and the second round of implementation. For those cases, some of the subsamples were subsequently selected (fixing a specific type of SCP). The approach is based on paired data of students for secondary school and low secondary, age >11.

The recommendations received from experts suggested "looking" at the micro-scale, since indeed the context of the data is very rich and the diversity in the projects is high, which a priori gives rise to a multitude of variables that were originally difficult to fit, or "control" taken into account our original framework of evaluation and for the analysis. This approach presents some "challenges" mainly related to the size of micro-samples (in such, questionnaires from groups of students involved in an SCP) and the great diversity of the context in which the projects have been developed (duration, type of project, tasks, age of the students, teacher experience, duration of the SCP, previous student experience in projects...). With this context the triangulation with the qualitative approach from the case studies is crucial, needed and rightful. Despite this, we believe that we have a very relevant data set by partner and as whole, through different cohorts and countries gathered at different rounds of implementation along the life of the MOST project. To analyze the data, one of the first assumptions we did was to consider, one as main "variable", students' perceptions *before and after the implementation* of SCP; we look at "the impact" or gains after the implementation. A first intention to report was to establish not only a descriptive way but also to carry out statistical analyses with the intention of making inferences and respond our research questions. Strictly speaking from the point of view of an experimental design of this type, we would be naive if we think that the effect would only be produced by the fact of having participated in the SCP (cause-effect). In any research we know that the control of variables is crucial, and, in this case, we have very diverse contexts. However, this is not an obstacle to having an adequate analysis that, together with the triangulation of the qualitative part, has offered us (coherently) results to be discussed about the overall positive measured effect ("evolution") that SCP has had on students.

From the point of view of statistical analysis, we decided to run **non-parametric** approaches for related samples (student responses in the premeasurement was paired with him/her responses using the anonymized code included in the questionnaires). Before that, at a first glance, we tried to look at the differences in terms of "means" and "medians" before and

after, trying to look at evidence of evolution (“gains”) in these scales and for those students. We must clarify the following: we thought to report the statistical data of central tendency (mean, standard deviation) for a better visualization of the data. But finally in this report we present the data of the non-normalized scales (number of items considered in “bracket close to the name of the scales, see tables) in order to a clear visualization and as output to be able to carry out the analysis of the Wilcoxon signed-rank test. As stated in Field (2009): *“the Wilcoxon signed-rank test works in a fairly similar way to the dependent t-test in that it is based on the differences between scores in the two conditions you are comparing”*. So, we are comparing the pre and post measurement as “scores” in that scales and we have used as “score” the sum of the values of the items withing each scale and subscale.

Using our previously validated scales (in this document, see the section related to the instrument) of **“Interest** (aka orientation) for science & scientific careers”, **“Relevance”**, **“Scientific literacy”** (split in **“Explanations”** and **“Evaluation”**) and **“Sustainability Consciousness”** (as sum of subscales of **Sustainability Knowledge** (here named as believes), **Sustainability attitudes** and **Sustainability behaviors**) one student could be “identified”/“assigned” with one score (in that scales) before and after the implementation. We do not intend to “quantify” how much higher or lower the score is by comparing individuals (since a priori we have not defined scales for it) but we can say that using the validated instrument in some way we ensure that an individual with a score of, let said, 40 on the sustainability scale (as sum of items scores in each scale) has a more positive or higher perception than one that has a score of 35. And this is where we try to measure to what degree an evolution has occurred after the implementation of the MOST SCPs.

Along this section we will analyze and present some piece of the quantitative analysis, in the context of our experimental design. A short view the most relevant data relating to the analyzes carried out is presented. Due to the heterogeneity of the sample, from the point of view of the consortium (size, type of projects, duration...) we thought that it is not feasible nor appropriate to make a comparison between the countries in terms of the scales associated to the pre and post measurement (we have not considered a multivariate analysis nor defined preliminary base-line study). The specific items only presented in the post test (related to the student’s enjoyment, interest, and self-efficacy perceptions after participation in the SPS) will be presented as a whole to try to have a figure related to *“What do European students think after having participated in the SCP in relation to... (interest, self-efficacy)?* Of course, it is to be expected that depending on the country there are nuances and differences.

The presentation of extended data or the details of all the calculations carried out for the statistical analysis, is beyond the scope of this document. In the next section some statistics and the main conclusions of the achievements have been collected. All of them has been summarized, giving an overall view of success, at the end of this section.

Data analysis and main results

The results are based on paired sample before and after the implementation of the SCP. The reported sample size is related to those cohorts. In some countries the number of gathered questionnaires is higher that the N reported here but sometimes we have found data lost (“blank responses”, low fit-matched index, perceived outliers, ae of students behind the required for the questionnaire, no anonymization code,). In any case, for example, for those



countries that have supplied a large N, a simulation was carried out considering the pre and post with the group of individuals, treating them as independent samples, that is, not pairing the individuals (e.g., Turkey, pre=512 post =437). The subsequent comparison in terms of gain and significance is aligned and consistent with both methods of analysis for large samples.



NETHERLAND

(N=11; matched and paired). Female: 40%, male: 60%.

Project: "Duurzaamheidsproject"

Table 1. Mean score (M, scale as sum of responses), standard deviation (SD), median for the scales in the pre-test and post-test measurement.

DIMENSION (N. ITEMS)	PRE				POST			
	M	SD	Mdn	N	M	SD	Mdn	N
* SUSTAINABILITY (15)	52,09	6,44	51	11	55,36	6,61	52	11
* SUSTAINABILITY_R (12)	40,82	4,75	41	11	43,82	4,73	42	11
* ENV_BEL (5)	17,55	2,73	18	11	19,73	1,79	19	11
ENV_ATT (6)	13,09	2,07	13	11	13,27	2,41	13	11
* ENV_BEHA (6)	21,45	3,08	20	11	22,36	3,29	22	11
ENVI_BEHA_R (3)	10,18	1,60	10	11	10,82	1,47	10	11
* RELEVANCE (4)	12,36	2,38	12	11	14,00	2,19	13	11
INTEREST (4)	11,18	3,71	11	11	12,45	1,69	12	11
SCIENTIFIC_LITERACY (8)	27,64	5,94	28	11	29,00	5,97	31	11
EVALUATION (4)	14,64	3,04	15	11	14,45	2,91	15	11
* EXPLANATION (4)	13,00	3,97	15	11	14,55	3,30	16	11

* $p < .05$

In this case, gains ($Mdn_{post} > Mdn_{pre}$) are detected in the four main dimensions. Using the Wilcoxon signed rank-test we have detected that the "**Relevance**", "**Sustainability consciousness**" does not show only gains but significant gains (Table 1). An example for the case of the "**Sustainability**" scale we can explicitly report as:

"**Sustainability**: results of the Wilcoxon Signed-Rank test indicated that there is a significant large difference between Before ($Mdn = 51, n = 11$) and After ($Mdn = 52, n = 11$), $Z = 2.5, p = .014, r = 0.9$."

If we analyze each of its subscales, we see how that the "**Evaluation**" has a pre-test with higher valued than in post-test, and the contrary for the "**Explanation**" subscale. Nevertheless, only the scale explanation present significant differences:

"**Scientific Literacy**: within this student group the "**Scientific Literacy**" seems to be significant $p < .047$ but we must be cautious in this case since the p statistic value is on the border). Thus, been in a cautious and conservative line let's say that it there is not significant changes in pre and post for this scale. Nevertheless, the observed effect size r is large, 0.64. This indicates that the magnitude of the difference between the mean ranks is large. A detailed review of its subscales reveals that:

“Evaluation: results of the Wilcoxon Signed-Rank test indicated that there is a non-significant very small difference between Before (Mdn = 15, n = 11) and After (Mdn = 15, n = 11), $Z = -0.2$, $p = .829$, $r = -0.08$.” The sample's change is considered to be equal to the expected change (0). In other words, the difference between the sample change and the expected change is not big enough to be statistically significant in this dimension.

“Explanation: results of the Wilcoxon Signed-Rank test indicated that there is a significant large difference between Before (Mdn = 15, n = 11) and After (Mdn = 16, n = 11), $Z = 2.3$, $p = .022$, $r = 0.9$. The population's change is considered to be not equal to the expected change (0). In other words, the difference between the sample change and the expected change is big enough to be statistically significant. Also, we can mention that the observed effect size r is large, 0.87. This indicates that the magnitude of the difference between the mean ranks is large.

We have done these detailed comments for this data set to show the rationale and analysis strategy behind the analysis carried out and the conclusions (so far). "In the following country-specific analysis sections, the same scale analysis data is provided, without going into detail of explicit statistical reporting, but including the table of statistical analysis.

A more detailed analysis of its sustainability subscales reveals that the improvement, above all, occurs in the area of **Sustainability Knowledge** (Environmental believes), and the whole scale of **Sustainability behavior** (on the contrary for the reduced one). The **Sustainability attitude** scale shows gains, but not significant ones. Here, therefore, we can infer (and this will be extended to the analysis of the rest of the countries) that the gain for one scale made up of subscales is diverse in nature and can come from the different combinations of gains in its subscales. At this point we take the opportunity to indicate that when we have a scale in which we have defined different subscales, the significant "gain" in the main scale can be "injected" by one of the subscales mainly on the other, even though there may be gains in both.

Table 1. Test statistics^a for Netherland

	SUSTAIN_POST -	SUSTAIN_POST -	ENV_BEL_POS	ENV_ATT_POS	ENV_BEHA_POS	ENV_BEHA_R_POS			SCI_LIT_POST -		
	SUTAIN	SUSTAIN	T - ENV_BEL	T - ENV_ATT	T - ENV_BEHA	T - ENV_BEHA_R	REL_POST - REL	INT_POST - INT	SCI_LIT	EVA_POST - EVA	EXP_POST - EXP
Z	-2,536 ^b	-2,059 ^b	-2,254 ^b	-,360 ^b	-2,640 ^b	-1,461 ^b	-2,448 ^b	-,775 ^b	-1,990 ^b	-,289 ^c	-2,384 ^b
Sig.	,011	,039	,024	,719	,008	,144	,014	,438	,047	,773	,017

a. Wilcoxon signed rank test

b. Based on negative Ranks (posttest – pre-est)

c. Based on positive Ranks

TURKEY

(N= 512 pre; 437 post (firstly treated not matched)). Female: 54.9%, male: 45.1 %.

As mentioned in the introduction for this section, the data set of Turkey was firstly analyzed as overall to have at a glance what happened using a “big sample” (no consideration about multivariable analysis was done here)

Table 2. Mean score (M, scale as sum of responses), standard deviation (SD), median for the scales in the pre-test and post-test measurement.

DIMENSION (N. ITEMS)	PRE				POST			
	M	SD	Mdn	N	M	SD	Mdn	N
* SUSTAINABILITY (15)	56,59	9,41	58	512	58,67	8,86	60	437
*SUSTAINABILITY_R (12)	47,96	8,21	50	512	49,67	7,75	51	437
*ENV_BEL (5)	19,95	3,86	20	512	20,76	3,68	21	437
*ENV_ATT (4)	15,62	3,07	16	512	16,28	2,95	17	437
*ENV_BEHA (6)	21,02	4,16	21	512	21,63	3,62	22	437
*ENVI_BEHA_R (3)	12,39	2,45	13	512	12,63	2,17	13	437
RELEVANCE (4)	17,11	2,97	18	512	17,33	2,84	18	437
INTEREST (4)	14,65	3,63	15	512	14,89	4,52	15	437
*SCIENTIFIC_LITERACY (8)	29,14	5,70	30	512	30,51	5,88	31	437
*EVALUATION (4)	15,03	3,14	15	512	15,66	3,07	16	437
*EXPLANATION (4)	14,11	3,26	14	512	14,85	3,42	15	437

In a first approach for analysis, considering the global sample of Turkey, to take advantage of the large of the student’s questionnaires, results show gains in the pre-post-test for all scales and subscales (Table 2). However, significant differences (in this case, using T-student for an independent sample), only seems appear in the “**Sustainability**” scale (and its subscales “**Knowledge**”, “**Attitudes**” and “**Behavior**”) and “**Scientific Literacy**” (and its subscales). The “**Relevance**” and “**Orientation**” scales did not show statistical significance a priori (it seems reasonable, since in a large sample the interests in science can be diverse and not all students will be scientists).

This first approximation offers us relevant information to be able to undertake the paired analysis. The data, with paired students, are coherent and aligned with these findings.

TURKIA (PAIRED)

(N=346 treated as paired). Female: 58.3%, male: 41.0%.

Table 3. Mean score (M, scale as sum of responses), standard deviation (SD), median for the scales in the pre-test and post-test measurement

DIMENSION (N. ITEMS)	PRE				POST			
	M	SD	Mdn	N	M	SD	Mdn	N
** SUSTAINABILITY (15)	56,62	8,82	58	346	59,04	8,12	60	346
** SUSTAINABILITY (12)	48,11	7,75	49	346	50,03	7,14	51	346
** ENV_BEL (5)	19,93	3,73	20	346	20,86	3,46	21	346
** ENV_ATT (4)	15,71	2,95	16	346	16,45	2,73	17	346
* ENV_BEHA (6)	20,97	3,72	21	346	21,72	3,44	22	346
ENVI_BEHA_R (3)	12,46	2,25	13	346	12,71	2,04	13	346
RELEVANCE (4)	17,25	2,62	18	346	17,40	2,76	18	346
INTEREST (4)	14,71	3,61	15	346	15,03	4,68	15	346
* SCIENTIFIC_LITERACY (8)	29,32	5,73	30	346	30,66	5,71	31	346
* EVALUATION (4)	15,13	3,09	15	346	15,67	3,00	16	346
* EXPLANATION (4)	14,18	3,27	14	346	14,99	3,32	15	346

**p < .001

*p < .05

For the paired sample of Turkey, the results found as non-paired (in a big sample) are replicated, that is, gains are reported in all scales (with different size effect), and dimensions of "**Sustainability**" and "**Scientific Literacy**" appear with significant differences (with gains) for the pre-test and post-test measures.

Table 4. Test statistics for Turkey

	SUSTAIN_R_POST	SUSTAIN_POST -	ENV_BEL_POST -	ENV_ATT_POST -	ENV_BEHA_POST	ENV_BEHA_R_POST	REL_POST - REL	INT_POST - INT	SCI_LIT_PST -	EVA_POST - EVA	EXP_POST - EXP
	- SUSTAIN_R	SUSTAIN_ALL	ENV_BEL	ENV_ATT	- ENV_BEHA	- ENVI_BEHA_R			SCI_LIT		
Z	-4,775 ^b	-4,880 ^b	-4,717 ^b	-4,317 ^b	-2,814 ^b	-1,796 ^b	-1,687 ^b	-1,120 ^b	-4,420 ^b	-2,899 ^b	-2,756 ^b
Sig.	,000	,000	,000	,000	,005	,073	,092	,263	,000	,004	,003

a. Wilcoxon signed rank test

b. Based on negative Ranks (posttest – pretest)

Following a general recommendation of expert EAB we proceeded to analyze, with a greater degree of detail, several clusters in the sample, understanding clusters as those groups of students who have developed or participated in the same SCP. This considerably reduces the "sample" but even so we can approach the analysis in some cases. As we have said before, the main conclusion is that SCPs can contribute in different ways to the gains (significant or not) of the different analyzed scales. Thus, for example, for the project "*Design of home devices powered by solar energy I*" gains are observed, but only with significance for the "**Scientific Literacy**" and its "**Evaluation**" and "**Explanation**" subscales.

Table 5 Test statistics^a for Turkey (one project)

	SCI_LIT - SCI_LIT_POST	EXP - EXP_POST
Z	-2,122 ^b	-2,125 ^b
Sig. asin. (bilateral)	,034	,034

a. Wilcoxon signed rank test

b. Based on positive Ranks (posttest – pretest)

LITHUANIA

N: 21 (paired). Female: 54.5 %, male: 45.5 %.

For Lithuania, higher values are observed in the post-test for all scales and subscales, but, on the contrary, the "Interest" scale shows a high value in the pre-test (although the effect size is small). The "**Sustainability**" scale shows significant gains, as well as its corresponding subscales. The "**Scientific Literacy**" scale also shows gains, although they are not significant (a detailed analysis does not allow stating with $p = .047$ that it is) but its "**Evaluation**" subscale does show significant differences, and the "Explanation" scale does not but present an effect medium effect size of 0.4.

Sustainability: results of the Wilcoxon Signed-Rank test indicated that there is a non-significant large difference between Before (Mdn = 15 ,n = 21) and After (Mdn = 16 ,n = 21), $Z = 1.9$, $p = .051$ (detailed), $r = 0.5$.

Evaluation: results of the Wilcoxon Signed-Rank test indicated that there is a significant large difference between Before (Mdn= 14 ,n = 21) and After (Mdn= 16 ,n = 21), $Z = 3$, $p = .003$, $r = 0.7$. This indicates that the magnitude of the difference between the mean ranks is big

Explanation: results of the Wilcoxon Signed-Rank test indicated that there is a non-significant medium difference between Before (Mdn = 15 ,n = 21) and After (Mdn = 16 ,n = 21), $Z = 1.7$, $p = .089$, $r = 0.4$. The observed effect size r is medium, 0.41. This indicates that the magnitude of the difference between the mean ranks is medium.

Orientation: results of the Wilcoxon Signed-Rank test indicated that there is a non-significant small difference between Before (Mdn = 11 ,n = 21) and After (Mdn = 9 ,n = 21), $Z = -1$, $p = .307$, $r = -0.2$. The observed effect size r is small, 0.24. This indicates that the magnitude of the difference between the mean ranks is small.

Table 6. Mean score (M, scale as sum of responses), standard deviation (SD), median for the scales in the pre-test and post-test measurement. Lithuania

DIMENSION (N. ITEMS)	PRE				POST			
	M	SD	Mdn	N	M	SD	Mdn	N
* SUSTAINABILITY (15)	51,81	5,83	53	21	56,33	6,07	57	21
* SUSTAINABILITY_R (12)	42,24	4,85	42	21	46,33	4,83	47	21
* ENV_BEL (5)	17,86	2,85	18	21	19,76	2,43	20	21
* ENV_ATT (4)	14,38	1,91	15	21	15,76	2,10	16	21
* ENV_BEHA (6)	19,57	2,93	19	21	20,81	2,75	21	21
* ENVI_BEHA_R (3)	10,00	1,70	10	21	10,81	1,60	11	21
RELEVANCE (4)	14,24	2,90	15	21	15,05	2,58	16	21
INTEREST (4)	10,10	3,27	11	21	9,57	2,91	9	21
* SCIENTIFIC_LITERACY (8)	29,10	3,73	30	21	31,71	3,91	31	21
* EVALUATION (4)	14,19	2,02	14	21	15,86	2,22	16	21
EXPLANATION (4)	14,90	2,14	15	21	15,86	2,13	16	21

*p < .05

Table 7. Test statistics^a for Lithuania

	SUSTAIN_POST - SUSTAIN	SUSTAIN_POST - SUSTAIN	ENV_BEL_POST - ENV_BEL	ENV_ATT_POST - ENV_ATT	ENV_BEHA_POS T - ENV_BEHA	ENV_BEHA_R_P OST - ENV_BEHA_R	REL_P - REL	INTPOST - INT	SCI_LIT_PST - SCI_LIT	EXP_P - EXP	EVA_POST - EVA
Z	-2,994 ^b	-2,777 ^b	-2,572 ^b	-2,735 ^b	-2,200 ^b	-2,411 ^b	-1,985 ^b	-1,043 ^c	-2,737 ^b	-1,726 ^b	-2,971 ^b
Sig	,003	,005	,010	,006	,028	,016	,047	,297	,006	,084	,003

a. Wilcoxon signed rank test

b. Based on negative Ranks (posttest – pre-test)

GERMANY

N=29 (paired).

For the analyzed sample, we found gains in almost all dimensions (not statistically significant), although the opposite was true for *“Interest”* in which a slightly decrease was measured. For this cohort of analysis, we have to consider the high degree of diversity in terms of variables (SPC, student age...) and the small number of questionnaires that fit the quality criteria of matching. The preliminary analysis, for the detection of significant differences, showed that these do not exist, and it is verified through the Wilcoxon sign test. However, we can show some effect sizes for the main dimensions, which are ranged from medium to small.

Table 8. Mean score (M, scale as sum of responses), standard deviation (SD), median for the scales in the pre-test and post-test measurement. Germany

DIMENSION (N. ITEMS)	PRE				POST			
	M	SD	Mdn	N	M	SD	Mdn	N
SUSTAINABILITY (15)	51,69	6,33	50	29	52,55	7,74	53	29
SUSTAINABILITY (12)	41,41	5,21	41	29	41,97	5,96	41	29
ENV_BEL (5)	18,52	2,86	19	29	18,66	3,51	19	29
ENV_ATT (4)	13,00	2,60	13	29	13,38	3,12	14	29
ENV_BEHA (6)	20,17	3,22	20	29	20,52	3,32	21	29
ENVI_BEHA_R (3)	9,90	1,70	10	29	9,93	1,60	10	29
RELEVANCE (4)	13,14	2,57	13	29	12,90	2,57	12	29
INTEREST (4)	9,66	4,45	9	29	9,90	4,34	9	29
SCIENTIFIC_LITERACY (8)	23,31	6,11	24	29	25,07	6,10	26	29
EVALUATION (4)	12,24	2,73	12	29	12,69	2,71	12	29
EXPLANATION (4)	11,07	3,51	11	29	12,38	3,74	13	29

“Scientific Literacy: results of the Wilcoxon Signed-Rank test indicated that there is a non-significant medium difference between Before (Mdn = 24 ,n = 29) and After (Mdn = 26 ,n = 29), $Z = 1.9$, $p = .064$, $r = 0.4$. The observed effect size r is **.37**. This indicates that the magnitude of the difference between the mean ranks is **medium**.”

“Sustainability: results of the Wilcoxon Signed-Rank test indicated that there is a non-significant small difference between Before (Mdn = 50, n = 29) and After (Mdn = 53, n = 29), $Z = 1$, $p = .320$, $r = 0.2$. The observed effect size r is small, 0.2. This indicates that the magnitude of the difference between the mean ranks is **small**.

CZECH

N=147 (paired)

For this sample, two out of the four scales show gains. The "**Interest**" and "**Relevance**" scales acquired higher values in the pre-test. In this case, it is noteworthy that in the studied sample, there is also a significant decrease in "**Interest**". According to the questionnaire results, a value with significant difference is identified."

"**Interest**": results of the Wilcoxon Signed-Rank test indicated that there is a significant small difference between Before (Mdn = 9 ,n = 147) and After (Mdn = 8 ,n = 147), $Z = -3$, $p = .002$, $r = -0.3$.

Table 9. Mean score (M, scale as sum of responses), standard deviation (SD), median for the scales in the pre-test and post-test measurement. Czech

DIMENSION (N. ITEMS)	M	PRE			N	POST			N
		SD	Mdn			SD	Mdn		
SUSTAINABILITY (15)	50,60	9,08	52	147	51,67	7,76	51	147	
SUSTAINABILITY (12)	41,71	7,84	42	147	42,43	6,65	42	147	
* ENV_BEL (5)	17,85	3,60	18	147	18,55	3,21	19	147	
ENV_ATT (4)	13,24	3,02	14	147	13,44	2,67	14	147	
ENV_BEHA (6)	19,51	3,95	20	147	19,68	3,38	20	147	
ENVI_BEHA_R (3)	10,63	2,42	11	147	10,44	2,21	11	147	
RELEVANCE (4)	13,75	2,80	14	147	13,52	3,27	14	147	
INTEREST (4)	9,22	3,66	9	147	8,46	3,39	8	147	
* SCIENTIFIC_LITERACY (8)	24,00	5,63	25	147	24,96	5,30	25	147	
EVALUATION (4)	10,96	3,09	11	147	11,88	3,05	12	147	
** EXPLANATION (4)	13,22	2,82	13	147	13,07	2,83	13	147	

**p < .001

*p < .05

For this group of students, we highlight that the "**Scientific literacy**" scale obtains significant values (although with a small effect size), with higher values in the post-test compared to the pre-test. However, the evidence suggests that the improvement occurs in the "**Explanation**" dimension. Although the "**Sustainability Consciousness**" scale does not show significant gains, one of its subscales, "**Sustainability Knowledge**," does show significant differences (though with a small effect size).

"**Sustainability knowledge**": results of the Wilcoxon Signed-Rank test indicated that there is a significant small difference between Before (Mdn = 18 ,n = 147) and After (Mdn = 19 ,n = 147), $Z = 2.4$, $p = .018$, $r = 0.2$.

Table 10. Test statistics^a for Czech

	SUSTAIN_POST - SUSTAIN	SUSTAIN_POST - SUSTAIN	ENV_BEL_POST - ENV_BEL	ENV_ATT_POST - ENV_ATT	ENV_BEHA_POST - ENV_BEHA	ENV_BEHA_R_POST - ENVI_BEHA_R	REL_P - REL	INT_POST - INT	SCI_LIT_POST - SCI_LIT	EXPL_POST - EXPL	EVA_POST - EVA
Z	-1,131 ^b	-1,572 ^b	-2,362 ^b	-,571 ^b	-,276 ^b	-1,226 ^c	-1,057 ^c	-3,026 ^c	-2,109 ^b	-3,832 ^b	-,677 ^c
Sig	,258	,116	,018	,568	,783	,220	,290	,002	,035	,000	,498

a. Wilcoxon signed rank test

b. Based on negative Ranks (posttest – pre-test)

SPAIN (round 3)

N=42 (paired test in round 3). Female: 62%, male: 38%.

Table 11. Mean score (M, scale as sum of responses), standard deviation (SD), median for the scales in the pre-test and post-test measurement. Spain (R3)

DIMENSION (N. ITEMS)	PRE				POST			
	M	DE	Mdn	N	M	SD	Mdn	N
* SUSTAINABILITY (15)	55,67	6,51	55	42	58,07	7,67	58	42
* SUSTAINABILITY (12)	46,00	5,30	45,50	42	48,17	6,51	47,50	42
** ENV_BEL (5)	18,10	3,19	18	42	19,93	3,21	20	42
ENV_ATT (4)	16,79	1,94	17	42	16,88	2,46	17	42
ENV_BEHA (6)	20,79	3,20	20,50	42	21,26	3,20	21	42
ENVI_BEHA_R (3)	11,12	1,86	11	42	11,36	1,99	11	42
RELEVANCE (4)	16,21	2,56	16	42	16,07	2,90	16	42
* INTEREST (4)	12,02	4,38	12	42	12,88	5,06	13	42
* SCIENTIFIC_LITERACY (8)	26,81	5,20	26	42	29,14	5,78	29	42
* EVALUATION (4)	14,24	2,85	14	42	15,17	3,13	16	42
* EXPLANATION (4)	12,57	2,80	12	42	13,98	3,19	15	42

**p < .001

*p < .05

Within the cohort studied we have found that within the three main dimensions **“Sustainability”**, **“Interest”**, and **“Scientific literacy”** present gains in relation to the post and pre measurement, and significant differences. Within the **“Sustainability consciousness”** the subscale **“Knowledge”** also show significant gains.

“Scientific Literacy”: results of the Wilcoxon Signed-Rank test indicated that there is a significant medium difference between Before (Mdn = 26 ,n = 42) and After (Mdn = 29 ,n = 42), Z = 3.1, p = .002, r = 0.5. Effect size: large

“Explanation”: results of the Wilcoxon Signed-Rank test indicated that there is a significant large difference between Before (Mdn = 12 ,n = 42) and After (Mdn = 15 ,n = 42), Z = 3.1, p = .002, r = 0.5. Effect size: large

“Evaluation”: results of the Wilcoxon Signed-Rank test indicated that there is a significant medium difference between Before (Mdn = 14 ,n = 42) and After (Mdn = 16 ,n = 42), Z = 2.2, p = .029, r = 0.4.

Table 12. Test statistics^a for Spain

	SUSTAIN -	SUSTAIN_R -	ENV_BEL -	ENV_ATT -	ENV_BEHA -	ENVI_BEHA_R -	REL -	INT -	SCI_LIT -	EVALUATION -
	SUSTAINA_POST	SUSTAIN_R_POST	ENV_BEL_POST	ENV_ATT_POST	ENV_BEHA_POST	ENVI_BEHA_R_POST	REL_POST	INT_POST	SCI_LIT_POST	EVALUATION_POST
Z	-2,626 ^b	-3,053 ^b	-3,640 ^b	-,590 ^b	-1,278 ^b	-1,143 ^b	-,531 ^c	-2,438 ^b	-3,149 ^b	-2,196 ^b
Asig.	,009	,002	,000	,555	,201	,253	,595	,015	,002	,028

a. Wilcoxon Signed Ranks Test

b. Based on positive Ranks (post-test – pre-test)

SPAIN

(Round 1&2)

N=48 (paired test in round 3). Female: 44 %, male: 56%.

Table 13. Mean score (M, scale as sum of responses), standard deviation (SD), median for the scales in the pre-test and post-test measurement. Spain (R3)

DIMENSION (N. ITEMS)	PRE				POST			
	M	SD	Mdn	N	M	SD	Mdn	N
*SUSTAINABILITY (15)	57,29	7,06	58	48	59,71	6,64	61	48
*SUSTAINABILITY (12)	47,04	5,51	48	48	49,33	5,40	50	48
* ENV_BEL (5)	18,94	3,22	20	48	20,15	2,85	20	48
* ENV_ATT (4)	16,04	2,31	16	48	16,90	2,29	17	48
ENV_BEHA (6)	12,06	1,76	12	48	12,29	1,65	12	48
ENVI_BEHA_R (3)	16,40	2,77	17	48	16,33	3,00	17	48
RELEVANCE (4)	12,21	4,03	12	48	11,92	5,19	12	48
INTEREST (4)	25,67	6,28	26	48	27,65	6,38	28	48
*SCIENTIFIC_LITERACY (8)	13,50	3,45	14	48	13,98	3,45	14	48
EVALUATION (4)	13,50	3,45	14	48	13,98	3,45	14	48
* EXPLANATION (4)	12,17	3,49	12	48	13,67	3,40	14	48

*p < .05

Table 14. Test statistics^a for Spain

	SUSTAIN_ALL - SUSTAIN_ALL_POST	SUSTAIN_R - SUSTAINPOST	ENV_BEL - ENV_BEL_POST	ENV_ATT - ENV_ATT_POST	ENV_BEHA - ENV_BEHA_POST	ENVI_BEHA_R - ENVI_BEHA_R_POST	REL - REL_POST	INT - INT_POST	SCI_LIT - SCI_LIT_PST	EVA - EVA_POST	EXP - EXP_POST
Z	-2,220 ^b	-2,498 ^b	-2,348 ^b	-2,900 ^b	-,692 ^b	-,893 ^b	-,102 ^c	-,652 ^c	-2,477 ^b	-,952 ^b	-3,254 ^b
Sig	,026	,012	,019	,004	,489	,372	,918	,514	,013	,341	,001

a. Wilcoxon Signed Ranks Test

b. Based on positive Ranks (post-test – pre-test)

c. Based on negative Ranks

If we compare two cohorts (rounds) we can see that both cohorts' gains are shared in main some dimensions but differ in others, mainly subscales. Also, both cohorts share the fact that values for **“Relevance”** for pre-test are higher than those for post-test but with no significant differences and small size effects. In terms of shared issues, for example, for both cohorts gains in the **“Scientific literacy”** domain are significant, but from round 1 & 2 gains came for the **“Explanation”** and round 3 came from both, **“Evaluation and explanation”**. This is an interesting result as it highlights the richness and uniqueness of the context and individuals. Even within a sample, if we conduct the analysis by projects, it could happen that, although gains are perceived (with different effect sizes), they may not be statistically significant) Otherwise, even if they are significant, each project may contribute significantly to different dimensions. Table 15 show numbers for “one specific” SCP. Gains are observed there, although no significant differences but they contribute with different size effects. Again, the effect in the relevance dimension appear in this project. It seems to be a “feature” for Spanish cohorts

Table 15. Mean score (M, scale as sum of responses), standard deviation (SD), median for the scales in the pre-test and post-test measurement. Spain (R3)

DIMENSION (N. ITEMS)	PRE				POST			
	M	SD	Mdn	N	M	SD	MDn	N
SUSTAINABILITY (15)	54,25	6,19	53,50	16	55,63	6,54	54,50	16
SUSTAINABILITY (12)	45,06	5,42	44	16	46,44	5,35	45	16
ENV_BEL (5)	17,81	3,29	17	16	19,00	3,16	18	16
ENV_ATT (4)	16,69	1,89	16,50	16	16,44	2,03	16	16
ENV_BEHA (6)	19,75	2,70	20	16	20,19	2,56	20	16
ENVI_BEHA_R (3)	10,56	2,03	11	16	11,00	1,59	11	16
RELEVANCE (4)	16,19	2,79	16	16	15,56	3,29	15	16
INTEREST (4)	12,31	4,00	12	16	12,94	4,51	13	16
SCIENTIFIC_LITERACY (8)	27,81	5,49	26	16	28,81	6,20	28,50	16
EVALUATION (4)	14,81	2,66	14	16	14,94	3,19	15	16
EXPLANATION (4)	13,00	3,22	12,50	16	13,88	3,36	15	16

Table 16. Test statistics^a for Spain. One SCP

	SUSTAIN_POST -		SCI_LIT_POST -	
	SUSTAIN	REL_POST - REL	INT_POST - INT	SCI_LIT
Z	-1,374 ^b	-1,633 ^c	-,992 ^b	-,830 ^b
Sig. asin. (bilateral)	,169	,102	,321	,406

a. Wilcoxon Signed Ranks Test

b. Based on neegative Ranks (post-test – pre-test)

c. Based on negative Ranks

NORWAY

Cohort 1, N= 96 (paired)

Project “Frag Vugge til grav” (N=59 paired)

Gains with different effect sizes are observed in almost all dimensions except for “**Relevance**”, where post-test values are significantly lower than pre-test values. Significant gains appear in the “**Scientific_literacy**” dimension and in its corresponding explanation subscale

Table 17. Mean score (M, scale as sum of responses), standard deviation (SD), median for the scales in the pre-test and post-test measurement. Norway

DIMENSION (N. ITEMS)	PRE				POST			
	M	SD	Mdn	N	M	DS	Mdn	N
SUSTAINABILITY (15)	43,91	6,45	44,50	96	43,94	6,03	44	96
SUSTAINABILITY (12)	41,74	5,32	42	96	42,14	4,52	42	96
ENV_BEL (5)	17,91	2,48	18	96	18,30	2,41	19	96
ENV_ATT (4)	14,03	2,55	14	96	13,93	2,30	14	96
ENV_BEHA (6)	20,07	3,08	20	96	20,10	3,10	20	96
ENVI_BEHA_R (3)	9,80	1,82	10	96	9,91	1,76	10	96
RELEVANCE (4)	14,55	2,35	15	96	13,63	2,49	14	96
INTEREST (4)	10,76	4,15	11	96	11,17	4,17	11	96
*SCIENTIFIC_LITERACY (8)	28,17	4,49	28	96	29,36	4,91	30	96
EVALUATION (4)	14,11	2,21	14	96	14,33	2,39	14	96
**EXPLANATION (4)	14,05	2,75	14	96	15,03	2,98	15	96

Table 18. Test statistics^a for Norway.

	SUSTAIN-	SUSTAIN_R-	ENV_BEL -	ENV_ATT -	ENVI_BEHA_R -	REL -	INT -	SCI_LIT -	EVA-	EXPL -
	SUSTAIN_POST	SUSTAIN_POST	ENV_BEL_POST	ENV_ATT_POST	ENV_BEHA_R_POST	REL_POST	INT_POST	SCI_LIT_POST	EVA_POST	EXPL_POST
Z	-,285 ^b	-,754 ^c	-1,247 ^c	-,654 ^b	-,640 ^c	-3,544 ^b	-1,457 ^c	-3,113 ^c	-,949 ^c	-3,888 ^c
Sig.	,776	,451	,212	,513	,522	,000	,145	,002	,343	,000

a. Wilcoxon Signed Ranks Test

b. Based on negative Ranks (post-test – pre-test)

c. Based on negative Ranks

For one SPC (N=59)

Results are aligned with the N=96 (seem to be coherent because it is part of the whole sample). Therefore, in the scale of interest it seems to appear significant gains.

“**Relevance**”: Results of the Wilcoxon Signed-Rank test indicated that there is a significant medium difference between Before (Mdn = 15 ,n = 59) and After (Mdn = 14 ,n = 59), Z = -2.4, p = .018, r = -0.4.

“**Interest**”: results of the Wilcoxon Signed-Rank test indicated that there is a significant medium difference between Before (Mdn = 10 ,n = 59) and After (Mdn = 11 ,n = 59), Z = 2.4, p = .018, r = 0.4. The observed effect size r is **medium**, 0.36. This indicates that the magnitude of the difference between the mean ranks is medium.

“Scientific Literacy: results of the Wilcoxon Signed-Rank test indicated that there is a significant medium difference between Before (Mdn = 28 ,n = 59) and After (Mdn = 29 ,n = 59), $Z = 3.6$, $p < .001$, $r = 0.5$. The observed effect size r is **medium**, 0.49. This indicates that the magnitude of the difference between the mean ranks is medium”

Table 19. Test statistics^a for Norway (1 SCP)

	INT_POST - INT	SUSTAIN_POST - SUSTAIN	REL_POST-REL	SCI_LIT_POST - SCI_LIT
Z	-6,553 ^b	-1,016 ^b	-2,369 ^c	-3,564 ^b
Sig. asin. (bilateral)	,000	,310	,018	,000

a. Wilcoxon Signed Ranks Test

b. Based on negative Ranks (post-test – pre-test)

c. Based on negative Ranks

Some about data for interest (about projects) enjoyment and self-efficacy

In the post-test, 7 more items were included to determine to what degree the student had a perception of self-efficacy in the enactment and **participation** of the project, and also her/his degree of interest and enjoyment. Although originally these were not perceived to be part of a scale, the *ad hoc* analysis of a validation (for Spain sample $C\alpha(7) = .819$ and for Turkey $C\alpha = .811$) with all the data sets in the post test revealed its consistency and gave as the chance to present results as “sum-up” of those items”. So, we present the data only post-items statistics as a whole, and describing the most relevant results. Although the analysis by item could offer a detailed view, we believe it is pertinent to carry out the analysis by scale. Although the sample size analyzed is country-dependent, we can conclude student’s perception has been very positive and his/her perception of interest and enjoyment could be related with her/his positive perception of self-efficacy.

Table 20. Items for interest, self-efficacy & enjoyment in the post questionnaire

33. I find school projects interesting	34. I am sure I can do well in school projects	35. The activities conducted in school projects are easy for me	36. I cannot understand the school project	37. I do not like taking part in school projects	38. I make good contributions in school projects	39. I enjoy participating in school projects
<i>Interest</i>	<i>Self-eff</i>	<i>Self-eff</i>	<i>Self-eff</i>	<i>Enjoyment</i>	<i>Self-eff</i>	<i>Enjoyment</i>

The correlation results reveal a strong association between these variables and between the self-efficacy scale and the item of interest and enjoyment. The values of the scores for each of the countries differ from each other (it seems obvious) but globally it could be considered that the perception of enjoyment is also aligned with the self-efficacy perception of the students.

Table 21. Correlations. Self-efficacy & Interest (cross-national sample, N=1272)

		Self-eff.	Interest	Enjoyment
Self-eff (34,35,36)	Pearson corr.	1	,817**	,689**
Interest (33)	Pearson corr.	,817**	1	,697**
Enjoyment (39)	Pearson corr.	,689**	,697**	1

** . Significant correlation at level 0,01 (bilateral).



Final remarks from the quantitative approach.

In this quantitative study, the findings regarding the analyzed cohorts and samples are quite promising in term of “evolution”. Table 22 presents a visual summary of the results obtained from different study samples within the context of the implementation and development of SCP in the MOST project. If look at the SCP in MOST as an **overall, a significant progress, we can name it as “evolution”, has been observed in almost all analyzed dimensions if considering our European context (within the consortium)** and highlighting dimensions of **“Sustainability consciousness”** and **“Scientific Literacy”**. However, it is important to consider the uniqueness of each SCP, the prevailing cultural and curricular context, which should be examined for each individual case. Additionally, in the study, we have analyzed small clusters, per project (further research has to be done in deep), and in this regard at a microscale, it can be said **that gains** (with or without significant differences) made in some of the dimensions analyzed (aligned with the macroanalyses), though not necessarily with statistical significance in all cases. We would like to clarify or point out that from our comprehension and interpretation of these data, small gains in clusters (SCP) can lead to significant impacts when the experience was scaled-up. That is to say, small gains in small contexts can become significant evolutions or changes when scaling up. **“It all adds up”**

Table 22. “At a glance” summary table of “gains” and results in the analyzed samples

	Main dimension				Subscales with sig. (dif. level, see previous tables)	
	S/S _R	R	I	SC		
Netherland	+*/+* (a)	+*	+	+	Sk, Sbh	Ex
Turkey	+/+ * (b)	+	+	+* (a)	Sk, Sat, Sbh	Ev & Ex
Lithuania	+/+ * (a)	+	-	+ *	Sk, Sat, Sbh	Ev
Germany	+/+	-	+	+		
Czech	+/+	-	-	+* (a)	Sk	Ex
Spain (R3)	+/+ * (a)	.	+*	+*	Sk	Ev & Ex
Spain (R1&R2)	+/* (a)	-	+	+* (a)	Sk, Sat	Ex
Norway	+/-	-*(b)	+	+* (a)		Ev

a.) $p < .05$; b.) $p < .001$

Codes for scales in this table: **S**: Sustainability Consciousness, **S_R**: Sustainability Consciousness (reduced), **R**: Relevance; **I**: Interest for Science/Scientific career, **SL**: Scientific Literacy, **Ex**: Explanation, **Ev**: Evaluation, **Sk**: Sustainability Knowledge, **Sat**: Sustainability attitudes, **Sbh**: Sustainability behaviors

22. Transnational case study analysis after a validation workshop

In the next sections, we will present the most relevant qualitative results coming out from the transnational analysis of the collection of case studies selected by the 10 partner countries, which according to the description of work, should provide at least 3 case studies per country.

For this report and as explained earlier when describing the qualitative methodology approach applied, we will mainly focus on those results that have been triangulated from different sources and outstood in a validation workshop engaging experts from 10 countries.

In the validation workshop partners from the 10 participating countries were asked to identify sound research evidence and low inference quotations from their selected case studies, which can provide us with strong research evidence to respond to the following evaluation questions:

1. What are the characteristics of **good SCP** and the **main barriers** for a successful implementation?
2. How are SCP **perceived by participants** and what are the main learning outcomes?

In the following sections, we present some illustrative results coming out from the transnational case study analysis that provide research evidence to discuss the overarching questions.

23. What are the characteristics of good SCP and the main barriers for a successful implementation?

The content analysis of the collection of regional case studies conducted across the 10 partner countries, along with the feedback received from the experts taking part in the transnational validation workshop, allowed us to distinguish the key features of what were considered exemplary SCP.

The following graphs represents the number of low inference quotations coded under any of the main categories that were successfully triangulated during the validation workshop.



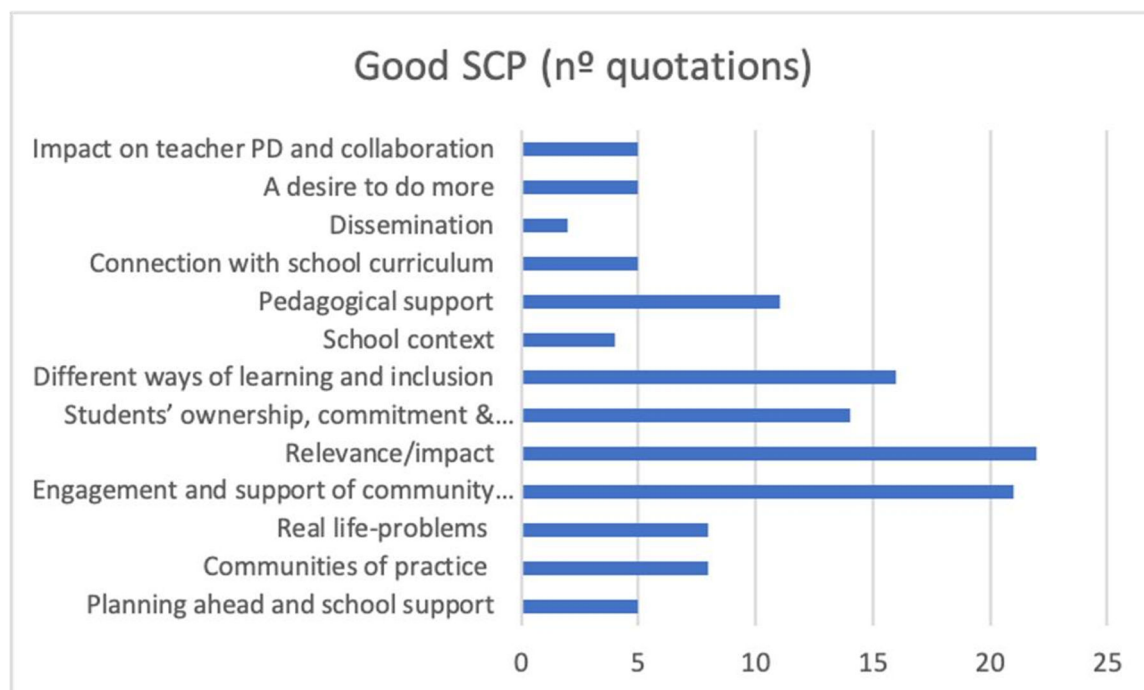


Figure above: Main characteristics of good SCP and number of low inference quotations triangulated under any category during the validation workshop.

We can see that the most prominent theme according to the number of quotations triangulated is related to the **relevance and impact** of the projects conducted, followed by the level of **engagement and support of community members**. These categories are very well aligned with other minor ones revealing that good SCP are considered as “real-life problems” that promote participants’ high commitment and a sense of ownership and empowerment in those people engaged. Other key feature that outstood from the validation workshop were related to the fact that SCP provide powerful opportunities to get on board students with different capacities and motivations, fostering **diversity and inclusion** and different ways of learning.

In relation to education, the collected evidence shows that, for teachers, is important to **plan ahead** and to get the **school support** as well as **specific pedagogical support** to design and run SCP and to **link them to the school curriculum**.

We present some quotations illustrating some of the previously mentioned categories and identifying the source of evidence:

Good SCP are designed to deal with real life problems

*“When students are presented with a **problem that is artificial or just for show**, they may become disengaged or feel that their time and efforts are not being valued” (teacher)*

*“... I like it because **I work on what will serve me in my life**” “This is the future!” “**All classes should be like this**” (student).*

“This is for real, not only school!” (student).

Good SCP are developed around relevant and impactful projects

“They value how relevant was the project for people” (Czech student).

“...the belief that the thing they are doing will help their lives and those around them...” (student).

“Students wants to grow more and to increase their impact in the community and raise the awareness people that could join their goals” (observer).

Good SCP are characterized by the engagement and support of community members

“Educating young people is a joint project, not just of teachers and parents, but of all of us. “Outsiders” bring new impulses and different ways of seeing and thinking to the school, which is why such projects are important” (stakeholder).

“...their presentation on climate change to the city council was meaningful and the city council members liked it. That's why they supported the project financially” (teacher).

“They understand that the strong point of the SCP has been intergenerational collaboration and the opening of the SCP to society” (observer).

Good SCP foster communities of practice

*“The cooperation of more teachers at school is important. When teachers **work together on a community** project, they can pool their resources and share the workload, which can lead to a more efficient and productive implementation process. Of course, there's always a teacher who's not interested. But you need at least some of the same mindset as you...” (teacher).*

*“The **collaboration between the different stages has been very enriching**, and we have seen how all the students from kindergarten to secondary education have collaborated. I believe that **programming** from children to high school can be **organized around these themes**” (school leader).*

*“I found the **teacher group quite engaged** and helpful in the learning process. I am not sure about its impact on teachers' professional development but can assume this project has had a **positive added effect on their collaboration skills** within the school environment and local community” (teacher).*

Good SCP promote participants' commitment, ownership and empowerment

*“...creating **serious commitment** to the SCP in initially **unwilling students** (teacher).*

*The **students display a central role** in the determining main questions of the SCP, doing research, collect data, reaching conclusions (teacher).*



*“The experience was **very empowering for the students** in fact two of the interviewees represented their school in a **parliamentary session** where school representatives (from ekoskola) share their environment-related concerns and recommendations with members of the Maltese parliament” (observer).*

Good SCP foster different ways of learning and inclusion

***All students are included and can contribute in some way.** As one student said, “everyone had some way of helping” (teacher).*

Awareness of **multiple interests/needs** involved (observer). *“...Projects enabling **different roles for students** (observer).*

*“The teaching staff has been able to detect skills in the **students that they would not otherwise have perceived, they have realized that students are very capable** and very competent children, which has a very positive effect on their motivation” (observer).*

*“SCP gave students **“an opportunity to flourish” by allowing them the “opportunity to talk to each other, reach a compromise, see things, experience, make mistakes and learn from their mistakes”** (teacher).*

Finally, the following graph represent the main themes arising from the content analysis of case studies in relation to the perceived barriers for a successful implementation:

Barriers for a successful implementation



Figure above: Number of low inference quotations triangulated in the validation workshop in relation to barriers for a successful SCP implementation.

The figure above shows that the main barriers to plan and conduct SCP are lack of time or experience from the point of view of participants. In addition, it is not always easy to

engage different stakeholders and some participants also mentioned lack of support as an important barrier for a successful implementation. Other themes commonly referred to are the importance of planning ahead and having a good communication that facilitate different stakeholders' engagement. Finally, teachers from different countries often expressed that they felt overloaded and very constrained by curriculum demands and the school organization.

24. How are SCP perceived by participants and what are the main learning outcomes?

In this section will present those results coming from the qualitative analysis of case studies that allow us to understand how different stakeholders perceived and/or experienced SCP and what did students learn from their participation in the projects.

In relation to participants' perception, the validation workshop allowed us to triangulate and highlight a wide variety of categories related to **positive feelings** such as **enjoyment, enthusiasm, satisfaction, proud and gratitude**. In the following, we include a couple of quotations to illustrate how participants described their experience, identifying the source where the quotation comes from:

*"It **felt pretty good**, because you know you do garden work, you do something for school, for the environment and for yourselves and others. So **that felt really good**" (student).*

*"It is always wonderful to see **how proud students can be** of their sustainability projects. And not only them. After planting the shrubs and trees isolating the traffic one mother said: **Thanks to the children** there will be reduction of air and noise pollution and it enhances aesthetic appeal of the area. Every green brunch helps" (teacher).*

Regarding the learning outcomes coming from students' participation in SCP, some quotations provide low-inference statements of the kind of STEM learning taking place and how SCP helped students to understand environmental problems and their role in solving them:

*"In relation to maths and statistics: survey analysis - **percentages, diagrams, average, area measurements/estimations**" (observer).*

*"They could recall and showed a deep understanding of **warmth/energy Flow** through materials" (observer).*

*"They learned about **chemistry elements** in the environment and the **environmental impact of devices** made of particular elements..." (observer).*

*"Sometimes the science behind the project didn't amuse them, but when they could do something practical, they always got excited. However, at least scientific concepts, such as the importance of **soil quality and water availability**...." (teacher).*



The quotations above illustrate how SCP provide students with interesting opportunities to make estimations, measurements and calculations that allow them to solve real life problems and to appropriately manage and interpret graphs and diagrams. In addition, the qualitative content analysis provides low-inference statements illustrating how students learned for instance, about energy, the quality of water and soil, the chemical composition of matter and its potential environmental impact, applying key science contents to make sense of some contemporary relevant problems.

In relation to students' understanding of sustainability issues and their role in solving them, the qualitative data coming from the regional case studies provide evidence of how SCP promoted interesting learning outcomes in this line:

*"Students now **understand better** the statement **"think globally and act locally"**. They think about wasting their food...they try to change their behavior and eating habits...They see a bigger picture of environmental problems (carbon footprint, etc.)" (teacher).*

*"My daughter has become **more conscious of human impact on climate change** and how we can combat climate change by reducing energy consumption. I found other pupils quite engaged in the process, they seemed to know quite a lot about energy production and **global warming**, as well as being keen to teach parents about **how to save energy** and money spent on electricity bills" (parent).*

Finally, case studies show how SCP foster a wide variety of other learning outcomes that are not usually achieved through conventional teaching and provide students with opportunities to develop soft skills related to cooperation, communication, or critical thinking. In the following, we present some quotations to illustrate these findings:

"We learned different things in the SCPs, things we wouldn't have learned in the normal classroom setting. Research on how to build raised beds" (teacher).

"...one of the positive characteristics of the SCP was that it also taught the children "life skills, how to cooperate, (and) critical thinking" rather than "just how to recycle" (parent).

"Parents, teachers, school leaders value soft skills, critical thinking and the engagement they gain" (observer).

"Being active citizens...be aware of what is happening around you. Do something about it!" (teacher).



25. Final remarks

This report is built on the data collected with the collaboration of the 23 partners institutions belonging to the 10 different European countries, where the MOST project was implemented. All the processes involved were aligned with the data management plan described in a previous project deliverable. Due to the strict requirements related the processes of data collection and data management (informed consents, anonymization and pseudonymization, respect of ethical principles and data protection laws), and the fact that participation was voluntary and very time-consuming, we feel very grateful for the generosity and high commitment showed by all the people involved in the process (researchers, teachers, students, parents and other community members). Their participation was crucial to gather enough evidence to evaluate the impact of the project.

Conventional statistics procedures for quantitative analysis and the triangulation of qualitative results were important to maximize the validity and reliability of results. However, due to the wide variety of national and socio-cultural contexts, the varied nature of the interventions considered under the umbrella of SCP and the complexity of the data collected, it is important to be cautious in the generalization of results and to bear in mind the characteristics of the samples used and the limitations of the study. It will be necessary to conduct more similar studies in the future, that could confirm or contrast these results, expanding our understanding of how to make the best of open schooling.

26. Other supporting bibliography

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