# Pedagogical Guidelines

# and

# Exemplary Science Materials

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## 1. Executive Summary

MOST (Meaningful Open Schooling Connects Schools to Communities) is a project under Horizon 2020, the European Union's programme for research and innovation 2014-2020. MOST aims to promote responsible research and innovation by opening up science education with the purpose of creating learning spaces, which are accessible for all citizens to join, and let society learn from, about and with each other. MOST introduced School-Community-Projects (SCPs) and showed how such projects can serve as a purposeful implementation instrument for Open Schooling. An SCP is a cooperation between students and their community. In an SCP, students and their teachers collaborate with members of the community: Families, science education providers, citizens, businesses, etc. They join to work on an environmentally relevant issue that directly affects their community and develop regionally feasible solution approaches. The acquired knowledge is then to be delivered to the community.

This Deliverable D4.2 contains two parts: Part 1 "Pedagogical guidelines", and Part 2 "Exemplary science materials". The main objective of Part 1 is to provide pedagogical materials that can be used as *educational* basis to run School Community Projects (SCPs). The main target group of this document is SCP leaders in their capacity as pedagogical leaders. The main objective of Part 2 is to showcase that Open Schooling in the MOST project has been implemented successfully through SCPs, and to present a collection of exemplary SCPs from each country. Part 2 is targeted to SCP leaders, and anybody interested to start, conduct or be inspired by SCPs.

The main pedagogical basis for SCPs stem from Project-Based Learning (PBL), a model that organizes students' learning around projects. PBL is often associated with Inquiry-Based Learning (IBL), Inquiry- Based Science Teaching (IBST) or scientific practices. The common denominator among these approaches is the student-centredness in which students are actively engaged in tackling problem-solving processes like raising questions to investigate, planning investigations, selecting methods, collecting data, evaluating and communicating results. In the MOST project, the scope of PBL/IBL has to be enlarged to include the community members, school director or stakeholders as participants, with the topic/theme covering authentic environment related issues (e.g. waste and energy) and promoting girls' participation. We have taken these into consideration in this deliverable.

In Part 1 – Pedagogical Guidelines – SCP leaders get insight into research-based pedagogical aspects relevant to SCPs. The guidelines are composed of *main features of SCP problems*, *main features of SCP ways of working*, *dissemination* of SCP, roles of *SCP leaders* and *valued outcomes*. Concrete examples from MOST country partners are given to illustrate how the guidelines were put into practice, and to make the document user-friendly. At the end of the guidelines, we present a section about digital SCPs to showcase valuable experience during the Covid-19 pandemic, and two appendices: The first one shows a stepwise guide on how to plan and perform SCP, and the second one gives a list of links of useful pedagogical resources for more details.



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In the main *features of SCP problems,* we give the pedagogical basis for why jointly decided, authentic problems are meaningful to the participants and contribute to their learning, including the relevance to girls. In the main *features of SCP ways of working* we address pedagogical principles derived from ways of working using student-centred and dialogic approaches. Multi perspective approaches to find solutions and gender responsiveness are also important features of ways of working. Next, we outline pedagogical considerations related to the *dissemination* of SCPs once they are accomplished.

In the *roles of SCP leaders,* we explain in detail how SCP leaders oversee the planning phase, provide guidance and scaffold (by providing frame, support structures and formative assessment), how they learn together with the participants, oversee the evaluation, and promote alignment to curriculum. The notion of *valued outcomes* is introduced next to enlarge the notion of 'learning outcome'. The latter is usually closely related to the curriculum's learning goals at specific school grades, while valued outcomes is related to knowledge, skills or attitude for life-long learning, and is relevant not only to students at school but all participants of SCPs.

We recommend that SCP leaders choose the part(s) of the guidelines that suit their purposes best, look into the links given in the Appendix 2 for more information, and/or let themselves be inspired by the ideas presented in Part 2 – Exemplary Science Materials – that follows the Pedagogical guidelines.

In Part 2 – Exemplary Science Materials – we present best practice exemplary science materials that are collected from each partner country. The examples presented in Part 2 show the diversity of SCPs in relation to school levels, age groups, duration, topics, students' products, outcomes, solutions and dissemination. The presented SCPs are considered exemplary because they have been impactful to students/schools/community members/the local community, they included a range of external actors outside school (e.g., members from business/industry, policy, non-formal education providers, wider society), they used authentic and socially relevant contexts and topics, were student-centered and inclusive for girls.

Exemplary SCPs are published online at the international MOST website (under the heading SCPs): https://icse.eu/international-projects/most/

For an overview of the conducted SCPs in the MOST project, please see MOST Deliverable *D4.1 European report on the solutions found in the School-Community-Projects*. D4.1 reports on numbers, solutions found, issues tackled, and lessons learnt, and shows how SCPs can contribute to responsible research and innovation.



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MOST Meaningful Open Schooling Connects Schools To Communities

# PART 1:

# Pedagogical Guidelines



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## 2. Pedagogical Guidelines at a Glance

The pedagogical guidelines are to be used in parallel with the MOST Deliverable D3.1 'Manual to Plan and Perform School Community Projects' henceforth referred to as WP3 Manual (https://icse.eu/wp-content/uploads/2023/03/D3.1-WP3-Manual-for-schools_final.pdf). The objective of pedagogical guidelines is to provide pedagogical materials that can be used as educational basis to run School Community Projects (SCPs). The main target group of this document is SCP leaders in their capacity as pedagogical leaders.

The main pedagogical basis for SCPs stem from Project-Based Learning (PBL), a model that organizes students' learning around projects. PBL is often associated with Inquiry-Based Learning (IBL), Inquiry- Based Science Teaching (IBST) or scientific practices. The common denominator among these approaches is the student-centredness in which students are actively engaged in tackling problem-solving processes like raising questions to investigate, planning investigations, selecting methods, collecting data, evaluating, and communicating results. In the MOST project, the scope of PBL/IBL has to be enlarged to include the community members, school director or stakeholders as participants, with the topic/theme covering authentic environment related issues (e.g. waste and energy) and promoting girls' participation. We take these into consideration in this document.

Figure 1 summarizes the content of pedagogical guidelines and how it relates to the INCREASE- Trail Map (Appendix 1). The summary offers an overview of main *features of SCP problems*, *features of SCP ways of working*, as well as the roles of *SCP leaders and valued outcomes*. Note that the INVITE step is not included in the pedagogical guideline because different actors can initiate an SCP and that the SCP leader can be chosen (or decided) *after* the initiation of the Invite step.

The main *features of SCP problems* are closely related to "Themes and Topics" in WP3 Manual, p.16; in this guideline we give the pedagogical basis for why jointly decided, authentic problems are meaningful to the participants and contribute to their learning, including the relevance to girls. These features need to be considered already in the Co-Create step. In the main *features of SCP ways of working* we address pedagogical principles derived from ways of working using student-centred and dialogic approaches. These features are crucial in the Co-Create and Act steps. In the Share step, we outline some pedagogical considerations when disseminating SCPs.

The *roles of SCP leaders* in these pedagogical guidelines encompass the Co-Creation, Act, Share and Evaluate phase. We present in detail how SCP leaders oversee the planning phase, provide guidance and scaffold (by providing frame, support structures and formative assessment), how they learn together with the participants, oversee the evaluation and promote alignment to curriculum. The notion of *valued outcomes* is introduced to enlarge the notion of 'learning outcome'. The latter is usually closely related to the curriculum's learning goals at specific school grades, while valued outcomes is related to knowledge, skills or attitude for life-long learning, and is relevant not only to students at school but all participants of SCPs.



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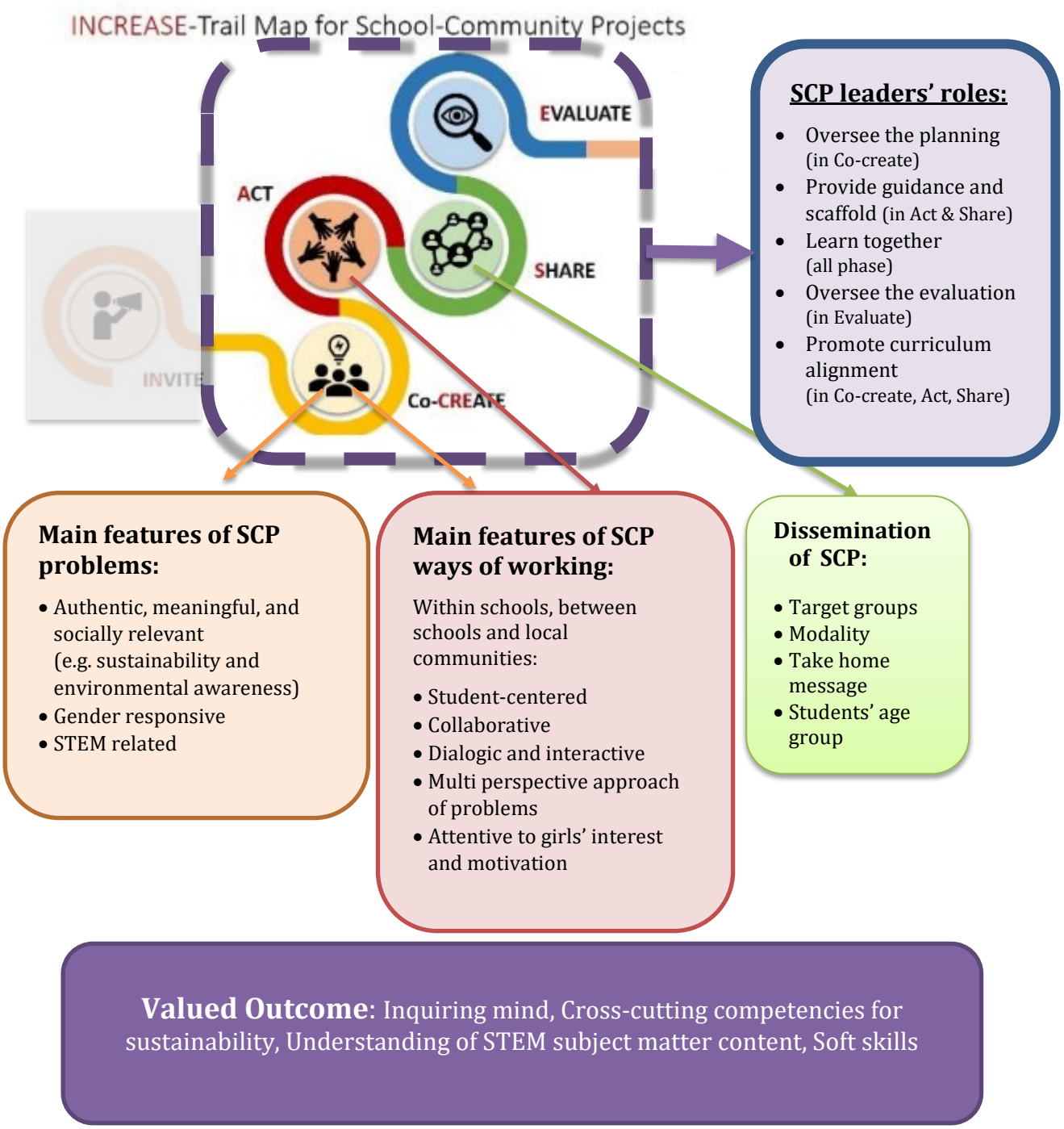


*Figure 1. Content in the Pedagogical Guideline and how it relates to the INCREASE-Trail Map from the Manual to plan and perform SCPs.*



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## 3. Introduction

MOST (Meaningful Open Schooling Connects Schools to Communities) is a project under Horizon 2020, the European Union's programme for research and innovation 2014-2020. MOST aims to promote responsible research and innovation by opening up science education with the purpose of creating learning spaces, which are accessible for all citizens to join, and let society learn from, about and with each other. MOST introduced School-Community-Projects (SCPs) and showed how such projects can serve as a purposeful implementation instrument for Open Schooling. An SCP is a cooperation between students and their community. In an SCP, students and their teachers collaborate with members of the community: Families, science education providers, citizens, businesses, etc. They join to work on an environmentally relevant issue that directly affects their community and develop regionally feasible solution approaches. The acquired knowledge is then to be delivered to the community.

During the MOST project each partner country implemented several SCPs. The size of an SCP depends on how big the school and community are and the number of people who express interest in participating. The main target group of this document is SCP leaders, who can be a teacher, a head teacher/ director, or a community member for example a student teacher, a parent, or a teacher educator (researcher). The objective of this document is to provide *educational* basis for SCP, therefore there are many considerations that stem from teaching-learning activities that a teacher will easily recognize and adapt to the context of classroom teaching. However, since we target a larger audience of possible SCP leaders, and that SCPs go beyond classroom teaching, we have enlarged these considerations to include all aspects in the MOST SCPs.

The pedagogical guideline is structured following the Co-Create, Act, Share and Evaluate steps in the INCREASE-Trail Map given in Appendix 1. We start by describing the pedagogical basis of SCP, then we outline the main features of an SCP problem. This answers to the question "How do SCP problems look like?" It is useful to be aware of these main features when participants sit together to define the problem during the Co-creation phase. Second, we outline the main features of SCP ways of working answering to the question "What aspects should be considered when participants work together in a SCP to find solutions to the problems?" These features are useful to be aware of already during the Co-Create step and to be implemented in the Act step. Next in the INCREASE-Trail Map is Share where we outline some pedagogical aspects to consider. Then we pull all the thread together and outline the roles of an SCP leader encompassing the steps Co-create, Act, Share and Evaluate. Following that, we present valued learning outcome of having worked with SCPs. Last but not the least, we give an example of a (thought) SCP that can be used as help and inspiration when SCPs are to be planned and performed, and how to conduct SCP under constraints such as during the pandemic. The Appendix 2 gives a list of links of useful pedagogical resources for more details.



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## 4. Pedagogical basis of SCP

The School Community Projects (SCPs) in the MOST project are based on the pedagogical approaches that stem from Project-Based Learning (PBL) (Thomas, 2000), a model that organizes students' learning around projects. PBL is associated with cooperative learning and inquiry-based approaches also known as Inquiry-based Learning (IBL), Inquiry-Based Science Teaching (IBST) or scientific practices (Crawford, 2014). These approaches involve learners (usually students at schools) tackling processes like raising challenging questions (or problems) to investigate, planning investigations, selecting scientific approaches, collecting data, seeking explanations, evaluating and communicating the results and proposed solutions. The problems' subject of the investigations can be challenging questions taken from authentic, realistic problems faced in real life (society). In the problem-solving processes through PBL or IBL, students not only apply, analyze and evaluate their existing scientific knowledge, they also are encouraged and engaged to create new knowledge in terms of the solutions proposed. This necessitates the development of higher order thinking as indicated for instance by the higher level in the Bloom's taxonomy (Anderson & Krathwohl, 2001). In this document we use the terms PBL and IBL interchangeably and sometimes together as PBL/IBL; in essence it covers student-centred teaching and learning.

Although schools play a central role as the hubs of the SCPs, the SCPs' participants include contributors outside schools such as stakeholders from business and politics or other community members (see WP3 manual). It is expected that each participant contributes with their expertise in the problem-solving process in innovative ways. The setting in which the PBL or IBL pedagogical approaches are employed in the SCPs become different than the 'usual' teaching-learning setting involving only teachers and their students that is largely documented in the literature (e.g Maaß & Artigue, 2013; Pedaste et al., 2015). The mechanism of learning and creation of new knowledge in MOST depends on the interactions not only between teachers-students or students-students, but also between teachers, students and the other contributors (see WP3 Manual regarding SCP participants). We see therefore the need for re-conceptualizing (re-defining) PBL or IBL when it is used as the pedagogical basis of SCPs, and this is done by outlining the main features and roles in the coming sections of this document.

## 5. Main features of SCP problems

In the sections that follow, we will elaborate on the overview given in Figure 1.

### Authentic, meaningful and socially relevant

SCP problems are meant to be real problems faced in the society, identified by the group of participants in a co-creation process (see WP3 Manual). Involving students in real societal endeavours, including the involvement in producing work of direct use to society, can be described



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as authenticity (Roth et al., 2008). Authenticity has been discussed in education for decades. The authenticity of science education not only concerns the design of educational activities, but also the content of what is being taught (Anker-Hansen & Andreé, 2019). Based on a series of empirical studies, Crawford (2012, p.39) state that when children engage in real-world, authentic investigations, connect their prior knowledge to new learning experiences, and are supported by a knowledgeable other in learning the cultural tools of science, they will gain a deeper understanding of science.

Authenticity to the learner does not necessarily mean that the topic is of cutting-edge importance to research scientists. The authentic science investigation may likely be embedded in a local community problem requiring a systematic approach for answering a question. SCP problems are supposed to be meaningful to participants, are purposeful and significant for everyday life. The findings may not revolutionize the scientific world, but the experience may revolutionize the learner's thinking (Crawford, 2012, p.39).

The fact that the SCP problems are co-created and stem from authentic situations in the participants' real-life entails *a shared ownership* (and shared responsibilities) among the participants (See WP3 Manual).

Problems related to the topics waste and energy are often socio-scientific issues with environmental, social and economic dimensions. Interdisciplinary approaches combining learning outcomes from several school subjects are socially relevant. There is no finite answer to the problems. Instead, there might be multiple possible solutions and solution strategies. To solve the problems, you need expertise from different participants, especially community members. Thus, SCPs can with advantage be broken into smaller, more specific sub-problems. For concrete examples of problems and sub-problems, see chapter 11.

## Gender responsive

Gender responsiveness relates to "paying attention to the unique needs of females, valuing their perspectives, respecting their experiences, understanding developmental differences between girls and boys" (United Nations Children's Fund, 2017, p.5). Girls are more idealistically oriented than boys. They want to contribute to something that is important for society, help other people, work with animals or contribute to find solutions to environmental problems (Schreiner et al. 2010, p. 100, see Sinnes & Løken, 2014). In female friendly science education, teaching materials should build on:

- girls' special interests and experiences
- incorporate scientific knowledge developed by females and oppressed,
- show examples of how scientific knowledge is biased by its developers,
- be political in terms of visualising the oppression of females and non-western people.

(Sinnes & Løken, 2014).



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### STEM Related

According to the WP3 Manual (p.6), the aim of SCP is to arouse interest in the natural sciences and scientific work in all participants which, in the long term, will lead to more youth in Europe to embark on a scientific career in the future. SCP problems should then be the types that require mathematical, scientific, or technological knowledge and skills to solve them.

EXAMPLES of SCP problems from 10 MOST partner countries:

A great range of SCPs explored different ways to solve the problems, different types of products, alternative and more sustainable practices both in the topic waste and energy. In some of them, calculations have been done, for instance how much carbon footprint can be reduced if we replace meat with funghi (Austria) and how much energy would have been saved if we use solar panel instead of electric heating (Turkey) or if we reduce the heating in the buildings during winter (e.g., Turkey, Norway). In some other SCPs study of everyday products such as olive oil (Malta), textiles (e.g., Lithuania, Germany), batteries (Norway), etc. have been done to understand the life cycle of those products and find out how to reduce waste during their production and how to re-use/upcycle them when these products become waste. In other SCPs the students mapped the flaws of current practices and looked for potential for improvements. For example, by calculating current plastic waste (e.g., Netherlands) or by identifying food waste in a school canteen (Czech Republic) and people's throwing habits (Lithuania) the SCP participants looked for ways to change practices into more sustainable ones (e.g., buy less – reuse more, etc.).

There were SCPs aimed at increasing awareness, such as of the importance of growing own vegetables to reduce food waste (Austria), and how to be more eco-friendly (Germany). Others built model cars fuelled by Hydrogen-cell (Germany) to study alternatives to fossil fuels, built solar cell model cars (Sweden), developed sensors for smart homes to optimize energy consumption (Turkey), and created art from school waste (Spain).

(For more information see Part II of D4.2 – Exemplary science materials and Deliverable 4.1. European report on the solutions found in the School-Community-Projects)

## 6. Main features of SCP ways of working

The WP3 Manual outlines SCP ways of working from the organizational point of view. In these guides we address the features of SCP ways of working from the pedagogical principles derived from student-centred and dialogic teaching and learning approaches. We include the girl perspective in addition.



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## Student-centred

Introduction wise, we presented the PBL and IBL as the pedagogical background for the SCPs. These are teaching and learning approaches in which students are presupposed to be actively involved, as opposed to the role of students as passive receiver of knowledge in the traditional approach. See §4. Pedagogical Basis of SCP for the description of what students usually do in PBL/IBL. These student-active approaches are aligned with suggestions from Wals and Dillon (2013) referred in Sinnes (2015, p.110) on methods for teaching for sustainability, in which students actively ask questions, investigate, and collaborate.

## Collaborative

The SCPs take place within schools, and between schools and local communities and stems from common interest among the participants. Due to the nature of the SCPs, it is recommended that projects are conducted as group work. However, not all group work automatically leads to effective learning unless the group work is carefully lead and managed by the teachers or SCP leaders.

A characteristic of effective group work is when the participants develop positive inter-dependency; they neither compete with each other (destructive inter-dependency), nor working individually without interaction inside the group (no inter-dependency). Strategies on how to structure and manage effective group work can for example be found in “Cooperative Learning” (link given in Appendix 2).

## Dialogic and interactive

It is important that the participants have a dialogic and interactive approach (Mortimer & Scott, 2003), are open-minded and respectful. For this, it is fruitful to practice exploratory talk which is characterized by the following (Mercer & Dawns, 2008):

- *everyone is actively listening and encouraged to contribute*
- *students ask questions and share relevant information*
- *ideas can be challenged and reasons for the challenges are given*
- *contributions are based on what has happened / been learned before*
- *ideas and opinions are treated with respect*
- *there is an atmosphere of trust and a sense of a shared purpose*
- *the group seeks or has an agreement on joint decisions*

In Appendix 2 “Visible Thinking” there is a link to strategies of thinking routines in the classroom that exemplify how these principles of dialogic, interactive, and exploratory talk can be put into practice. In addition, SCP leaders and participants should be aware of the value of failure. Mistakes must be seen as a valuable component of the learning process, and as part of the progress towards an optimal solution to the problem.



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## Multi perspective approach of problems

Socio-scientific issues are characterized, among other things, by the fact that they do not have one specific solution. Therefore, the strategy to solve SCP problems is not unique, rather it implies a multiple perspective and multi-disciplinary approach. This means that we may need to address environmental, social, ethical, political, as well as economic implications in addition to learning the STEM subjects (Fensham, 2012).

EXAMPLE FROM NORWAY Covering the above features of ways of working.
*Blue Light: How to reduce its impact on people's health?*

The Year 4 class (age 9) worked with the theme "Blue light". The children have identified the problems related to overuse of screen devices during and in the aftermath of the Covid-19 pandemic. The class was divided into groups who worked in finding solutions to the different problems. Some groups worked on solutions to blue light hurting their eyes; they investigated facts about blue light and created informative posters, while another group made fake models of blue light filters like glasses and visors. The filters had the size of a mobile phone, a laptop screen, a desktop screen and glasses, so they had to make measurements of those devices. They also wrote letters to the school leadership to ask for blue light filters for the school devices. The students recommended that the school invests in blue light filters. Other groups worked on making electric circuits, created campaign videos, made games/ quizzes (Kahoot), did inquiries on electric energy and its consumption, such as the advantages and disadvantages of different types of power plants (hydro, nuclear, solar, etc.) and made prototypes from recycled materials. The students engaged in a variety of activities including surveys and questionnaires both in school and in the community, involving local businesses. They went out to the city center, talked to people on the street; they involved parents and other family members.

(More about the project, see PART II – Exemplary science materials, p. 68)

## Attentive to girls' interest and motivation

In female friendly science education, teachers should be responsive to girls' special interests and motivation. Sinnes and Løken (2014) outline some examples of strategies to achieve this:

- *teach in small groups,*
- *develop a non-competitive environment in science class,*
- *focus on health/body and personal development whenever possible,*
- *link science education to girls' out of school experiences,*
- *link science education to societal/environmental issues,*



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- *visualise the masculine bias in scientific knowledge and priorities, visualise the special contributions of females to science,*
- *pay extra attention to females in class.*

**SUGGESTIONS** based on EXPERIENCE from 10 MOST partner countries.
Strategies to engage girls or promote inclusive SCPs:

- Every SCP participant regardless gender, should be given the possibility to participate in every single step of the SCP,
- Try to use mixed gender groups in SCPs (exception: in some cases, pure girls' groups might feel as a safe space to work and co-create, girls' teams might motivate girls to engage in SCPs),
- If you run activities that were previously known as stereotypically male or female activities, try to include both boys and girls,
- Work with role models, e.g., use female SCP leaders and female community members or experts. Use of female referents is a strategy that has proven to be effective in promoting scientific vocations in girls and reducing the existing gender gap in this area,
- Build a learning environment in which the students feel accepted and safe. The trust built in a group lead to a situation in which everyone feels free to contribute, take initiatives and work towards the group's common target,
- Use active learning and hands-on instructional strategies. These are recommended to improve science education for females.

## 7. Dissemination of SCP

Once the SCP has successfully been carried out, there are different ways to disseminate the SCPs and the solutions found. See WP4's Deliverable 4.1 for examples of SCPs and solutions found and see the SHARE step in the WP3 Manual (p.20-23) for different ways of sharing.

When it comes to pedagogical considerations, there are several aspects worth considering:

- Target groups: Whom are you sharing the SCPs and solutions to?
- Students' age group and abilities
- Modality: How are you going to share? Which forum? Does the chosen modality suit the students' age group and abilities?
  Ensure that the students are equipped with the necessary skills. For instance:
  - *(if the MOST dissemination activity is digital): Do the students have the digital skills necessary to prepare and participate at the activity? If not, how can a training be provided?*
- What are the main take home messages do you want your target group to get?



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## 8. SCP leaders' roles

In the MOST project, schools play an important role as the hubs of the SCPs. It is expected then that SCPs are initiated by schools and that most probably the SCP leader is either be a head teacher or a teacher, at least at the start. However, as mentioned earlier, there is possibility that the SCP leader is chosen from other participants such as student teacher or a community member, for example a teacher educator (researcher) or a parent. It is expected that this happens once the SCP participants are established, and the projects are defined.

In this part we will outline the general roles of the SCP leaders as pedagogical leaders by referring to the phases in the INCREASE Trail Map provided in the WP3 Manual.

### Oversee the planning (In Co-Create)

Once the topic is identified (see WP3 Manual p.13-16), the problems should be formulated as research questions and it is the SCP leaders' role to make sure that the questions are *researchable* (can be solved) by using procedural and content knowledge appropriate to students' age group and ability, in science and mathematics as well in other school subjects.

In this phase it is also recommend planning on what types of guidance and support structures the participants will need in the next step.

### Provide guidance and scaffold (in Co-Create, Act and Share)

Traditional science or math problems lead often to one correct answer and that the answer usually can be found in the textbooks. In contrast, SCP problems have the characteristics of being authentic which are sometimes complex and rather unstructured with multiple possible solutions. Literature on PBL and IBL shows that the leader's *guidance* is pivotal to successful project-based or inquiry-based learning (e.g. Kirschner et al., 2006). Learners who are given an **adequate** amount and an **appropriate** type of guidance act more skilfully during the task, are more successful in obtaining topical information, and score higher on tests of learning outcomes administered after the inquiry (Lazonder & Harmsen, 2016). Hence it is important that the SCP leader think *in advance* how to provide such guidance and/or facilitate the co-creation of it in collaboration with the participants.

One way to provide such guidance is by providing participants with: ***Frames, support structures and formative assessment***, see Figure 2.



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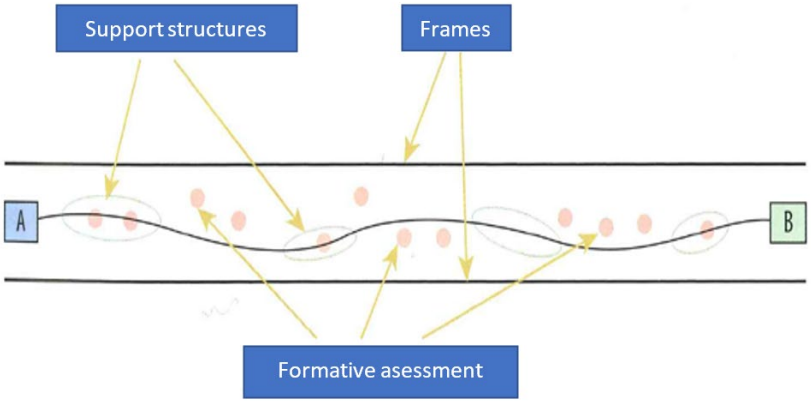


*Figure 2. Guidance facilitating students' learning through PBL/ IBL projects (Knain et al., 2019 based among others on Hmelo-Silver et al., 2007)*

We will elaborate the different parts of the guidance below:

### *Frames*

In WP3 Manual (p.3, 19) it is outlined the general frame of the project. In this part we complement the Manual by outlining the frames from the pedagogical point of view.

**The frames** (see Figure 2) around the problem (or sub-problems) give the general context which forms the background of the SCP problem (or sub-problems), such as the overarching topic/ theme, the aim, and the starting point. The frames also limit the extent of the SCP problem (or sub-problems) in terms of for instance the choice of method, the stages to follow and the time constraints. Besides, the frames describe the expected outcome at different stages, such as goals (see WP 3 Manual about SCP goals, p. 16), benefits for community members involved, learning outcome of students, evaluation and assessment forms. The frames also tell the participants about the group size and the task distribution. Unless the frames have been decided elsewhere, the SCP leader has to think/plan the frames in advance. If possible, it may be a good idea of **discussing the frames already in the CO-CREATE phase, so that the participants may have the shared ownership of the frames**.

Furthermore, the frames should be age group appropriate. For instance, SCPs done by primary school children might have less complexity and less difficulties or cover a smaller scope than those tackled by lower or upper secondary school students.

The group size might be dependent on the student age group, the complexity of the problem and the scope of investigation. For instance, for the youngest students (aged 6-10) one whole class (e.g. 20-40 students) may work with *one* SCP of relatively small scope. While for older students (aged 10-14, 15-19) we may let them work in smaller size groups (e.g. 5-10 students/group), each tackles a



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sub-problem of an SCP of medium-high or high complexity. The point is, there should be some flexibility in grouping the students, and the SCP leader is responsible in defining the limitation of the scope and complexity, and further defining group sizes. This can be done when the SCP leader know *the participants' pre-knowledge and experience* (see a separate section further down).

Examples of questions for discussing frames:

- *What is the overarching topic (theme) and the aim(s) of this SCP?*
- *What problem(s) do we want to solve? Is (are) the problem(s) authentic in terms of a real environmental issue for the (local) society?*
- *What information do we have as a starting point of SCP?*
- *Can this problem be divided into sub-problems? How? How many? What issues will each sub-problem address? Who will do what in each sub-problem?*
- *What limitations of the SCP problem should we think? E.g. in terms of topic limitations, area, time, numbers of informants, etc.*
- *How are we going to divide the students into groups?*
- *What time frame do we have? Plan of progression? (see also WP3 Manual)*

### *Support structures*

**The support structures** (see Figure 2) are tools the participants get to help them progress and to ensure a good quality of their work. The number of tools and their types should be appropriate to the students' age groups and abilities, as well as the expertise of community members involved and the tasks. The tools can play the roles of scaffolding when the students carry on the SCPs. It is usually the teachers who prepare the tools for the students' use when they work using the PBL or IBL approaches. Within MOST, it is the responsibility of the SCP leader to think of the tools and facilitate the co-creation of the tools together with the teachers in case the SCP leader is not a teacher. Examples of tools:

- Templates, e.g. for planning investigation, documenting methods and results, reporting, etc.
- Appointing roles within student groups and distributing tasks based on the strengths and interests of each group members.
- List of known facts or information sheets necessary for the students to move forward.
- Tips for students on how to conduct exploratory talk
  (see Thinking Together Resources in Appendix 2)
- Tips for students on how to communicate with participants outside schools, such as business partners, NGO, etc. These may be especially useful for younger students.
- Hints for students to anticipate progress, for example questions such as:
  - *What have you tried so far? Is there another way of doing this?*
  - *What do you know? What are you trying to do?*
  - *How can you be more systematic here?*
  - *What can you do to find out if there has been mistakes somewhere?*



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- Timely scheduled progress meetings where groups can meet and discuss progress underway, learn from each other, give each other feedback, evaluate the quality, and decide on the next steps. Such meetings require:
    - Preparations from all participants
    - Communication rules to create an atmosphere of trust
- Assessment criteria.

The SCP leader with or without the collaboration with the participants need also to anticipate the ***timing*** when the different tools should be made available to the participants, and *who* will provide them.

### *Formative assessment*

**Formative assessment** in Figure 2 is part of the guidance, but we choose to present it as separate section due to its substantiality. Formative assessment includes assessment *for* learning and assessment *as* learning, as opposed to summative assessment or assessment *of* learning. In assessment for learning teachers evaluate learners' progress underway and use the information to decide on the next steps to be taken to move student learning forward. Formative assessment can be done spontaneously during the lesson or integrated in the lesson plan (Black et al., 2003). Whenever possible, it is recommended to include Formative Assessment in the CO-CREATE phase so that SCP leaders can plan the SCP with formative assessment in mind and involve the participants in co-creating the criteria. In this case, the SCP leader has the role of facilitating this. Examples of questions to help preparing formative assessment criteria are:

- *What are the features of a good/less good problem? How can we formulate the research question in such a way that it is researchable?*
- *What characterizes good/less good hypotheses?*
- *What characterizes an effective teamwork? Or an effective communication?*

Three central processes of formative assessment are to elicit: *the learners' prior knowledge* (see the section "Connect to pre-knowledge and previous experience" below), *where they are heading to* (learning goals, valued outcomes), and *what to do in order to help the learners achieve the learning goals/ valued outcomes* (William & Thompson, 2007). Learners should be informed about the learning goals and what are expected of them. At different stages, they should get feedback on the quality of their work and how to improve. Learners should also be involved in assessing their own work (self-assessment) and assessing each other's' work (peer-assessment). This is because self- and peer-assessments provide opportunities for learners to reflect on their own learning, what strategies they use, whether the strategies enhance or hinder their learning, and eventually adjust their strategy. This process promotes the development of metacognition such as self-monitoring and self-regulation. The assessment practices become thus part of the learning process, and in this regard, we talk about assessment *as* learning. Teacher guides on peer- and self-assessment are given in the PRIMAS project (see link in Appendix 2).



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To connect to the participants' pre-knowledge and previous experience is important to be considered in the Co-Create and Act phase the SCP can be tailored and build up accordingly. Examples of questions to help connecting to participants' pre-knowledge and previous experience:

- *Have the students work with project-based or inquiry-based learning approaches before? If yes, what experience that can be useful for working with these SCPs? If no, what do we need to do to enable them to work with SCPs?*
- *Which knowledge in science and math have the students previously acquired that is relevant for the SCPs?*
- *What skills have the students previously mastered in terms of e.g. doing investigations, communicating, collaborating that can be useful in solving the SCP problems? What new skills they will have to learn underway while working with SCPs?*
- *What expertise can community members contribute with? What relevant previous experience do community members have?*

**What should be assessed formatively?** Regarding assessment of inquiry skills and competencies, the SAILS project has summarized the points of what should be assessed (see link to SAILS in Appendix 2):

- *Planning investigations*
- *Developing hypotheses*
- *Forming coherent arguments*
- *Working collaboratively*
- *Scientific reasoning*
- *Scientific literacy*

SCP leaders can adapt and add their own items such as the assessment of communication skills and sustainability competencies.

**Formative assessment methods** are various. The SCP leaders can for instance conduct classroom dialog with the students, do observation of the students' work, collect student materials, facilitate students' presentations for example during the regular meetings, facilitate student self- and peer-assessment, etc. These assessment items inform the SCP leaders on what feedback the students need to help them progress.

Here are some examples of assessment criteria:

- Ability to find suitable technological solution to the problem
- Socio-scientific knowledge and skills, e.g. that students know about and can:
  - *Appreciate the inherent complexity of the issue*
  - *Analyze the different perspectives of an issue,*
  - *Explain the contextual nature of the problems,*
  - *Argue about the scientific evidence,*
  - *Recognize the need for information about the uncertain nature of science,*
  - *Employ healthy skepticism to the information,*
  - *Evaluate the role of technology in the society, etc.*

(Partly adapted from the discussion about Assessment of SSI Learning in Fensham, 2012).



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Below are some examples of collected students' work, they can be employed independently or in combination with each other:

- **Portfolio of documentation:**
  *The students are asked to document neatly every stage of the project by writing log, taking pictures, making videos, recording data, the solutions to SCP problems etc. and collect them in one set of portfolios (can be digital) that they deliver at the end of the project. It is important that the portfolio shows the transparency of the procedure and contains reflections about what worked well/ not well and why, argumentation of the solution(s) based on data and about the collaboration.*
- **Tests**; specially design to match the valued outcomes of SCPs with SCP way of working.
- Student **presentations** during MOST Fair (see WP3 Manual, Share step)

## Learn together

In the traditional teaching approaches where teachers are the one who "transmit" knowledge and students are passive receivers, it is common to think of teachers as the one who knows the answer to the problem. While in the MOST project, the participants are faced to an authentic problem that none of them know beforehand what best solutions will be. This requires a shift in the teachers' and SCP leaders' role, not anymore as the knowledge "dispenser" but as the ones who learn together with the students. At the overarching level, not only the students and their teachers who learn together, we believe that the head teachers and the community members also learn something in the process of solving SCP problems. Examples of questions or prompts to promote learning together:

- *I am not sure about this matter, why don't we investigate it together?*
- *I do kind of agree with your suggestions, however, let's look from this angle…*
- *I do not know more than you do, why don't we …. / what about if we do this or that?*
- *(referring to a community member) You are the expert in this matter, what is your point of view?*
- *You have found this (solution), what does this mean? (to you, or to the project)*

At classroom level, teachers as SCP leader can benefit from some practical advice for teaching problem solving dealing with unstructured problems (see Tackling unstructured problems, PRIMAS project, link in Appendix 2).

## Promote curriculum alignment

The MOST objectives are most effectively and efficiently achieved through a whole school (institution) approach, where the SCPs are integrated as part of the school's development plan and aligned explicitly to the curriculum.



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Due to the very nature of SCPs that deal with complex, authentic and sometimes controversial issues, the alignment to the curriculum can be achieved by interdisciplinary approaches combining learning outcome from several school subjects, for instance through combining the Science and the Geography curricula, or the Science, Mathematics, Social Studies and/ or languages curricula, as well as Technology for example. The SCP leader should plan for a deep integration of the curriculum from the beginning. Do not consider only strict content. SCPs are a way of covering general skills like citizenship education, education for sustainable development, scientific literacy, and communication skills. SCP leaders must be creative and extend the topic.

To align the curriculum, it will also be easier to align the skills-based learning goals with some subject goals also being appropriate to an SCP project. Additionally, in some educational systems, there is also a requirement to complete a service project which an SCP focused on local issues related to environmental concerns could fulfil.

EXAMPLE from NORWAY: *How to embed SCPs in the curriculum?*

One of the participant schools in Norway worked to make SCPs become an integral part of the curriculum instead of an "add on". The school developed a model of SCP implementation in which SCPs were anchored in the International Primary Curriculum (IPC) (IPC: https://www.goodschoolsguide.co.uk/international/curricula-and-exams/the-international-primary-curriculum). The teachers and the school leader analyzed the alignment between features of SCP problems and ways of working, the INCREASE Trail-Map and the learning processes in the IPC. This alignment was communicated to all school staff, students, and parents to get them onboard. For instance, the Year 4 and 5 teachers identified a teaching unit called "Full Power!" in the IPC which also encompassed the Sustainable Development Goals. The year 4 and 5 students were then divided into groups based on their areas of interest within the overarching theme "Energy". Year 5 focused their research on sustainable heating energy in private homes and in local businesses. Year 4 focused on the energy and well-being, the effects of blue light on people's health.

The SCP allowed them to work cross disciplinary, combining science (learning about renewable and non-renewable energy sources, sustainable methods of using and storing energy, power plants, electric circuits) with English language (writing letters and making presentations), Design & Technology (making prototypes of power plants), and Mathematics (doing statistical analysis, measurements & calculation to make prototypes).

## Oversee the evaluation

The strategies and tools to evaluate SCPs are elaborated in the WP3 Manual. Here we would like to complement with some consideration from the pedagogical point of view. Since schools, teachers and students are the hub of the SCPs, learners' age group and ability need to be considered in conducting evaluation. For instance, student surveys or other data collection tools (see WP3 Manual) should be written in a language that they understand.



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## 9. Valued Outcomes

Research has shown that IBL can have a positive impact on learners' achievement and attitudes towards science (Aktamis et al., 2016; Bergem et al., 2016; Bruder & Prescott, 2013). IBL promotes transversal skills and allows all learners (regardless of gender, culture, health-condition and so on) to work scientifically because they work at their own pace and use different kinds of skills (cf. Maaβ & Artigue, 2013; Mischo & Maaβ, 2012).

Due to the concept of open schooling and the nature of school community projects (WP3 Manual), the term 'learning' refers not only to students' learning at school, but encompasses a larger context both formal and informal, at school or outside school, and the learning of the students, the teachers and the community members participating in the SCPs through cooperative activities. In the context of MOST we expect to achieve the following 'Valued Outcomes':

### Inquiring minds: critical and creative

Working with SPCs promotes the development of inquiring minds; critical and creative. Inquiry skills include the ability to formulate research questions based on authentic problems in the society, to formulate hypothesis, to plan and carry out investigations, to present and discuss the results. The cognitive processes involving scientific reasonings using logic and building coherent arguments will be enhanced. Observations and data collected from the real world are subject for testing, critiques and argumentations; statements are subject for explanations based on evidence; there will be need for creative thinking in order to look for innovative ways of finding the best solutions to the problems (e.g. Osborne, 2014). PBL and IBL as the basis of MOST pedagogical approaches has earlier been reported to lead to improved attitudes to learning, self-esteem and creativity. It helps students acquire problem solving and critical thinking abilities, better work habits and deeper learning (Thomas, 2000).

### Understanding STEM subject matter content

As SCP partners make authentic connections to real life, particularly to cross-cutting environmental issues like the topics covered in MOST they learn to apply procedural and content knowledge from science and mathematics in real life. Implementing real-life problems has the potential to raise interest, support scientific understanding due to tangible examples, foster scientific literacy and show the relevance of science (Queiruga-Dios et al., 2020). Not only the students and the teachers, but the community members will also benefit from these valued outcomes since they will be actively involved in the problem-solving process.



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EXAMPLE from TURKEY:

How to calculate the cost of generating electricity with solar energy in schools and homes?

Solution proposed: 287 solar panels can be installed for the school. The installation of the system costs approximately 78.000 dollars. The installed system works for an average of 25 years. The first 5 years cover the cost and the remaining 20 years provide an advantage. Generating electrical energy by installing solar panels is a costly process during the installation phase. However, when considered in the long term, it is advantageous despite performance losses.

STEM content: electric energy, cost calculations, energy production in solar panel, roof areas, etc.

## Cross-cutting competencies for sustainability

To be able to solve the SCP problems related to environment students need to develop certain key competencies that allow them to engage constructively and responsible. These cross-cutting key competences are generally seen as crucial to advance sustainable development (UNESCO, 2017):

- *Systems thinking competency*
- *Collaboration competency*
- *Critical thinking competency*
- *Self-awareness competency,*
- *Problem-solving competency*
- *Anticipatory competency*
- *Normative competency*
- *Strategic competency*

These key competencies can be understood as transversal, context independent and multifunctional, meaning they encompass certain situations and context. They do not replace the specific scientific or mathematical competencies necessary to solve a problem in a specific context. The development of these key competences should happen at age-appropriate level. The competencies are explained in Figure 3 below (taken or adapted from UNESCO (2017) and other references):



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**System thinking competency:**

Abilities to recognize and understand relationships; to analyze complex systems; to think of how systems are embedded within different domains and different scales; and to deal with uncertainty.

**Self-awareness competency:**

Abilities to reflect on one's own role in the local community and (global) society; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires.

A pre-requisite for the development of Facione's (1990) critical thinking skills in the context of education for sustainable development.

**Anticipatory competency:**

Ability to understand and evaluate multiple futures – possible, probable, and desirable; to create own's visions for the future; to apply the precautionary principle; to assess the consequences of actions; and to deal with risks and changes.

**Critical thinking (CT) competency:**

Abilities to question norms, practices and opinions; to reflect on own one's values, perceptions and actions; and to take a position in the sustainability discourse. CT relates to ***dispositions*** or ***skills*** (Facione, 1990)

*Dispositions: Attitudes or habits of mind and can be described as the inner motivation that promotes a critical thinking to apply their critical skills.*
*Six categories of skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation skills.*

**Collaboration competency:**

Abilities to learn from others; to understand and respect the needs, perspectives, and actions of others (empathy); to understand, relate to and be sensitive to others (empathic leadership); to deal with conflicts in a group; and to facilitate collaborative and participatory problem solving. Students who work collaboratively generally perform better than those working alone (e.g., Pfeiffer et al., 1987).

**Normative competency:**

Abilities to understand and reflect on the norms and values that underlie one's actions; and to negotiate sustainability values that underlie one's actions; and to negotiate sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions.

**Strategic competency:**

Abilities to collectively develop and implement innovative actions that support sustainability at the local and global level.

**Problem solving competency:**

Overarching ability to apply different problem-solving frameworks to complex sustainability problems and develop viable, inclusive, and equitable solution options that promote sustainable development.

**Problem-solver attitude: others open-mindedness, being flexible, dispositions to consider a wide range of alternatives, belief in their own ability to solve the problem at hand, and view of a problem or a mistake as a challenge or an opportunity to learn rather than a source of frustration (Pfeiffer et al., 1987, p. 105-106).**

**Problem-solver skills: ability to see the larger pictures and not getting lost in unnecessary details, to analyze the complexity of problems and break down into manageable portions, to apply relevant procedural and content knowledge to the problems, to anticipate possible outcomes of different strategies employed, to think critically at all stages, and to communicate the results (e.g. Osborne, 2015; Pfeiffer et al., 1987; Thomas, 2000).**

*Figure 3. Cross-cutting competencies for sustainability*



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## Soft skills

Working in SCPs promotes students' competency and skills dealing with communication not only within schools (with teachers or classmates) but outside schools as well (e.g. community members, stakeholders). Thus, SCPs offer students the opportunity to develop their soft skills and language skills in a real-world context. For instance, students will learn on how to communicate ideas in ways understandable to others, positioning themselves with respect to each other's and to other SCP partners, negotiate the terms of the project, conduct, and participate to meetings and/or exhibitions either digitally or non-digitally, etc. In order to do so, they have to learn to make conscious language choice to shape the intended purpose of communication, to use a range of sources, organizational and presentation features to match with the target audience (e.g. Sanders, 2003). Not only students, but the SCP leaders and community members will also take benefit in developing their communication and collaborative skills, since they have to adapt their communication style to the students' abilities and age group.

EXAMPLES of learning from MOST partner countries related to Valued Outcome

Students learnt about solar energy (e.g., Austria, Turkey, Sweden), importance of learning skills on how to grow own vegetables, to clean water (Austria), re-cycle and up-cycle waste (Germany, Czech Republic, Lithuania, Spain, etc.). Families, parents, staff members, students and community members learnt about permaculture (Malta). SCP participants in all countries learnt on environmental and climate friendly behavior and cultivated awareness around it. They also developed soft skills, such as communication, teamwork, empathy, time management, problem solving in addition to being resilient and ethical.

# 10. Example: SCP on Waste management

We give here an example of a (thought) SCP that can be used as help and inspiration when SCPs are to be planned and performed. In Part 2 we present best practice examples of materials from the 10 MOST partner countries.

## How to deal with plastic waste in the sea?

A school in a coastal municipality in Norway decides to run an SCP. For this municipality, plastic in the sea is a serious environmental problem, because of plastic waste that is brought ashore by wind and sea currents. Hence, it is decided to run the SCP with plastic in the sea as its overriding theme. Participants are a science teacher (SCP leader) at the school and students in his class, parents and representatives from the municipality, local companies and organizations.

Although this is a thought example of an SCP, this is unfortunately an authentic issue for many coastal communities. It is estimated that worldwide 5 -12 million tonnes of plastic end up in the sea every year (United Nations, 2020). Most of the plastic sinks to the seabed or is washed ashore. As



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an example: The company *Eider AS* at *Mausund Field Station* collects marine waste along the coast of Central Norway. Since 2017, approx. 4000 m³ has been collected, most of which is plastic waste, see Figure 4.

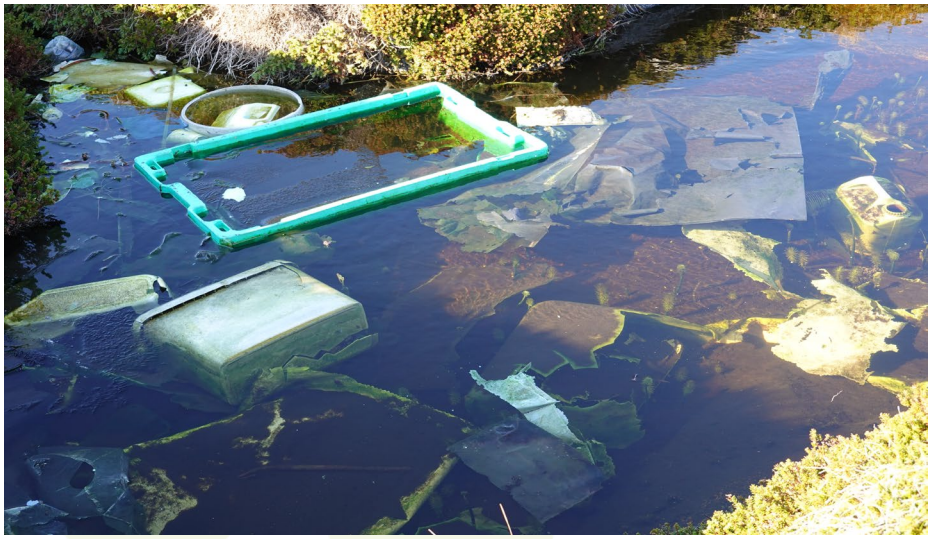

*Figure 4. Plastic waste washed ashore on a small island (Mausund) on the Norwegian coast west of Trondheim. Photo: Hilde Ervik/NTNU*

We elaborate our thought example further by following the same thematic overview in the *Pedagogical Guidelines* (see figure 1), and by following the phases in the INCREASE Trail map in the WP3 Manual.

### *Participants and leaders*

In the initiation phase, a science teacher at the school was chosen as the SCP leader.

Participants in the SCP were students from the eighth grade in secondary school (age 13), four of the parents (one of them an employee in the municipal waste company), another employee from the waste company and one employee from a local environmental protection organization that specifically works with pollution in the sea. Later in the project, a journalist from a local radio station, a chemistry student and a physics student who both live in the municipality also joined the group.

### *Problems*

The topic that was selected for this SCP was plastic waste on seashores which is an increasingly urgent topic in coastal communities in Norway. The main problem was defined as what can the municipality and society in the area do to reduce the problem of plastic waste along its shorelines.



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This complex problem was divided into several sub-problems through discussions between the participants. In the process of defining sub-problems, the expertise of the different participants was utilised to develop good working hypotheses. The sub-problems that were decided on was:

- *Which categories is it relevant to sort the plastic waste into?*
- *How can the different sections best be processed by the municipality and waste handling company?*
- *Based on the findings in the sampled area, what would be the volume of waste expected along the whole length of the shoreline in the municipality? Develop a draft plan for handling of plastic waste along the shorelines in the municipality.*
- *Investigate the possible origin for the waste and what measures could be taken to contribute to the reduction of waste production from these sources?*

The main problem and the sub-problems with the corresponding learning activities were aligned by the teacher to the relevant curriculum.

### *Ways of working*

Following the MOST project's pedagogical ideas, the work in the groups was centred around the students with the other participants supporting the students. Emphasis was placed on assuring that all students' voices were heard and that the dealings within the group were respectful and open-minded. The different sub-problems allowed students to seek out tasks suitable for their interests and preferred ways of learning.

### *The role of the leader*

The SCP leader had a role throughout all phases of the project (See WP3 Manual).

INVITE: To motivate and inspire the students, the leader, who is himself a science teacher, held a kick-off lesson on the topic of waste management and on sustainability and environmental awareness. Together with the students, the leader invited local stakeholders to an orientation meeting. The leader made sure that participants with different backgrounds were invited, such as from science and research, lay people, and NGOs. The purpose of the meeting was to invite and include participants in the project.

CO-CREATE: It was already decided that the theme should be plastic waste in the sea, but in an interaction between students and the various stakeholders, the project was developed and detailed so that all partners in the project felt a commitment to the theme. This important process was led by the SCP leader.

For the SCP leader, it was important to link the various sub-tasks in the project to the students' prior knowledge in science. Among other things, he identified several topics from the curriculum in science where learning could be achieved through the project.



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ACT: The project was carried out over a period of four weeks. Such a long period was possible because parts of the project could be embedded in the curriculum in Science and Mathematics. The project also provided relevant tasks for the teaching of Norwegian and English. More than half of the written sources the students used were in English, and during the project the students communicated in writing in Norwegian and English both with participants in the project and with other resource persons.

A timeline was set, and the leader kept track of it. In periods where the project was behind schedule, it became an important task for the leader to make the project participants realize this and to motivate them to find solutions that drove the project forward.

SHARE AND EVALUATE: An important part of the SCP is the communication of the findings. In this project, a plan was made for communication with the local community through the project and for presentation of the results. Together with the SCP leader, the students organized an exhibition at the school and a campaign where students and their families reduced plastic consumption. The results from the SCP project will be presented at an upcoming MOST Fair. It is the responsibility of the SCP leader to facilitate this presentation.

The summative assessment of the students' work was based on portfolios where different texts were included, among them a report to the municipality on findings and recommendations, a web site with illustrations from the project and a blog with reports from the practical work in the field.

***Valued outcomes***

Through the work on the project, the students gained experience in communicating both in writing and orally with each other, with experts and with lay people. For example, they discussed types of plastic with the chemistry student, employees in the waste company and journalists. They applied knowledge from science and mathematics to real problems, such as calculations of volume and weight of the waste collected. They developed their inquiring minds by working together to find good solutions and saw the value and necessity of being able to make a critical assessment of available information and their own data when parts of the information and results were in conflict.

## 11. Digital SCP

During the Covid-19 pandemic, we adapted flexibly the way of working to constraints. Different scenarios were discussed: (a) ideal -schools function normally, anybody could come into school (b) part of the students were at school, part at home, (c) all students at home, no visit between families, (d) students at school but nobody from outside could visit school. We seriously explored and exploited the possibilities of conducting digital format SCPs, collective work with families and addressing problems close to home. Advantages of digital format SCPs are: Everyone can follow communication in a chat, stakeholders and community members with limited time can be included (no travel time to meetings), possible use of applications or other digital artefacts, and expand the possibility of cooperation.



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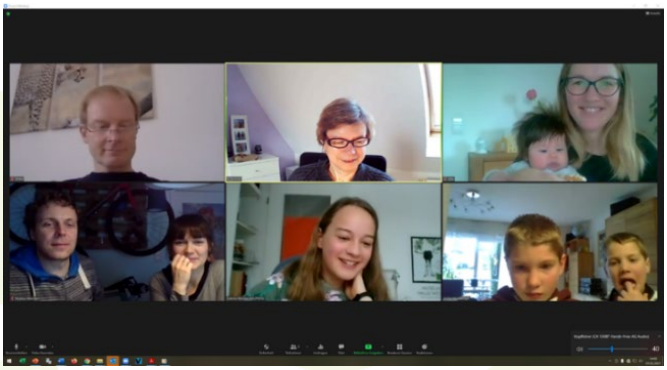
Through the Covid19 year we have all become experts in digital communication. The list in the WP3 Manual include links to activities and digital tools which might be useful in online meetings, online teaching and online evaluation.

EXAMPLE from GERMANY of a DIGITAL SCP with a topic close to home
"How to reduce plastic waste from the bathroom?"

The participants of this SCP composed of a scientist, research assistants, a teacher, a business representative of the renewable energy sector; all with their families involving students from primary and secondary schools. They were all concerned about the abundance of plastic in their households and decided to co-create an SCP about plastic waste from the bathroom. The SCP was in the middle of the pandemic lock-down.



They had four digital meetings with the following structure:

**Session 1**

*Why reduce plastic waste?*
*What do we use in the bathroom?*
*What alternatives we know?*
*How effective is making your own cosmetics?*

**Session 2**

*How can different waste types be recycled (plastic, glass, paper)?*
*Which alternatives are usable, which are not very good?*
*How about the costs (what is more expensive – „traditional"version or eco-version?)*

**Session 3**

*Which products do we want to use?*
*What products do we want to recommend?*
*What are key messages we want to convey?*

**Session 4**

*Working on recommendations*
*Working on pictures for the messages*

In between the meetings they worked on tasks, each had a different one, e.g. one person did research on recycling, another did experiment on how to make your own soap, and some others worked on market research (where you can get alternative products like shampoo, cosmetics, detergent and which ones are good alternative).



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The SCP resulted in the following recommendations:

- Switch to recycled toilet paper.
- Reduce using products made of plastic or that come in packaging containing plastic; for instance, use rather wooden toothbrushes (however the packaging is very extensive, made of cardboard and compostable plastic).
- Use natural cosmetics; they are not available in the local store but can be purchased on the Internet. Tip: Order large quantities.
- It has not been possible to find packaging-free hand cream in the local trade, use shea butter as alternative. Shea butter can also be used as a body lotion.
- Make your own cosmetics, creams, and cleaning products. Recipes are provided.

The results were disseminated via flyers and posters in the schools and via social media.

## 12. Conclusions and Recommendations

We have developed Pedagogical guidelines that serve as educational basis to run SCPs. The principles outlined in these guidelines are informed by research and exemplified by experiences distilled from practices conducted by the 10 MOST partner countries during the project.

The Pedagogical guidelines are structured following the Co-Create, Act, Share and Evaluate steps in the INCREASE Trail Map from the WP3 Manual. The content of the guidelines complements the WP3 Manual the extract of which is given in Appendix 1. We recommend that SCP leaders choose which part(s) of the guidelines that suit their purposes best, look into the links given in the Appendix 2 for more information, and/or let themselves be inspired by the ideas presented in Part 2 – Exemplary Science Materials – that follows the Pedagogical guidelines.

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# 14. Appendix 1: Extract of Manual to plan and perform SCP

## Everything at a glance - A short guide for Open Schooling projects for teacher

School is often stressful; there is a lot to do, class preparation, corrections and more. To support you we have summarized the content of the manual "to plan and perform SCP" on two pages. Further explanation on the single steps as well as best practice examples can be found in the main part of this document (The INCREASE -Trail Map for School Community Projects).

**Why Open Schooling?**

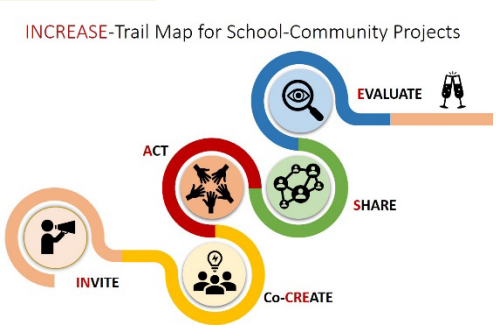
Open Schooling (OS) is about “breaking down the barrier between the school and what takes place in the real world.” (SCP leader from Norway). The Open Schooling approach invites students to work on current environmental issues together with stakeholders coming from hands on experience. The core of OS is the collaboration between schools and communities; this is why the single projects are known as School-Community projects (SCP).

**The frame of the project**

Before the start of the actual project it is crucial to talk about the idea of carrying out an Open Schooling project with the headmaster and the involved students. Further, it is helpful to define an appropriate timeframe of the SCP. As it is a bottom up approach, projects are more creative, innovative and successful, if the students are free in their decision of the topic. There is also the possibility to connect the SCP with the curriculum. The INCREASE-Trail map provides further information to carry out SCPs successfully.

### INCREASE -5-steps to success

The path to the results of an SCP is seldom a straight one; rather it meanders through the various phases of a project. In order to be able to follow the process successfully, we recommend orienting yourself to the 5 phases of a project.




*(Fig. 1: INCREASE-Trail Map, own illustration)*

### INVITE

After the students decided on a rough topic or initial ideas for the SCP, the search for possible stakeholders begins. As a teacher, you can now support your students by providing contacts. Invite other community members or people relevant to your topic. To get in contact it is advisable to make phone calls to get in a conversation, where students can present their idea. Invite as much interested stakeholder as possible to bundle common interests. If the students need help in starting a conversation, it is recommendable to provide support.



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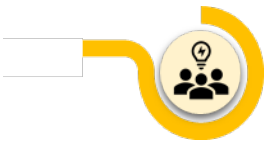
## CO-**CRE**ATE



Co-creation enables specialists and experts to **cooperate** with other groups with whom an exchange normally does not take place. Co-creation processes help to find a **topic**, and similar **interests** of the participants become visible, from which **project groups** can be derived. A selection of methodological approaches to facilitate the process can be found in the Co-creation Navigator (https://ccn.waag.org).

## **A**CT

This step marks the start of the visible part of a SCP and makes it clear to what extent the previous steps were successful. It is recommended to implement the following steps to reach the objectives of the project and generate success. Best practice examples from the MOST project can be found here.

| **Define the objectives:** | **Responsibility:** | **Keep in touch:** | **Timeframe:** | **Risks and mitigation:** |
|---|---|---|---|---|
| What are you aiming for with the project? | Share responsibilities by assigning individual members of the project team a role that suits them | regular project meetings support the exchange | Set a timeline – a list of milestones helps the students to orientate themselves in the project | Talk about stumbling blocks and how to overcome these |

## **S**HARE

Since this is a school community project, whose results reach out into the neighborhood and can be interesting for a broad community, it is advisable to present the completed projects to the community. Therefor there are various options, starting with a science fair, organized by the students, presentations via poster, using internal communication channels in school, provide videos on social media platforms or working together with local newspaper/radio station.

## **E**VALUATE

Since it should be part of every scientific process, it is recommended to evaluate the SCP. It is useful to see whether the project was successful or the approach needs some adjustments. Further it is helpful to receive feedback from the students learning process. A short evaluation is possible through a short feedback talk with the students. Questions should be formulated concretely and wide so that the pupils can talk openly about their experiences in the project.

The complete Manual can be downloaded here:
https://icse.eu/wp-content/uploads/2023/03/D3.1-WP3-Manual-for-schools_final.pdf



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## 15. Appendix 2: Useful pedagogical resources

| Link* | Description | Information |
|---|---|---|
| PRIMAS project<br><br>https://primas-project.eu/modules/modules-english/ | **Teacher guides and handouts** on student led inquiry, tackling unstructured problems, learning concepts through IBL, asking questions promoting reasoning, leading collaborative work, building on what students already know, self and peer-assessment. | Useful guide for SCP leaders; mostly for school use but can be adapted to IBL projects involving actors outside school. |
| SAILS project<br><br>http://www.sails-project.eu/units.html | **Framework on formative assessment** for inquiry-based learning.<br>Examples of **inquiry-based projects** implemented in classroom with **embedded assessment practices**. | Some of the projects mentioned in the examples touch the environmental issues. Useful to see examples how teachers and pupils can work on these topics and how formative assessment framework was put into practice. Also useful to hear teachers' reflections on their experiences. |
| PARRISE project<br>https://www.parrise.eu/<br>https://www.parrise.eu/booklets/ | They provide **teacher training materials and classroom examples** on how to involve students in socio-scientific issues. A **booklet** is available in several languages. | The booklet is for teachers who want to expand their teaching approaches to include socio-scientific issues which enrich and give meaning to core scientific principles.<br>It is meant to enhance young people's curiosity about the social and scientific world and raise important questions about issues which affect their lives. They call this approach Socio-Scientific Inquiry-Based Learning, or 'SSIBL' for short. |
| Thinking together<br>https://thinkingtogether.educ.cam.ac.uk/ | Examples on **dialogue-based approaches** to the development of children's thinking and learning. | Resources for teachers and teacher-trainers to use to develop their own and their students' awareness of how talk is used in classrooms. |
| Visible thinking<br>https://www.inquisitive.com/blog/2019/03/27/visible-thinking/ | A Teacher's Guide to Visible Thinking Activities | A practical guide to using thinking routines in the classroom, with quality ready-to-use activities for each type of routine. |
| UNESCO learning objectives<br>https://unesdoc.unesco.org/ark:/48223/pf0000247444 | UNESCO, 2017. **Education for sustainable development goals: learning objectives.** | Useful description of goals and key competences. |
| Bibliography STCSE<br>http://www.archiv.ipn.uni-kiel.de/stcse | STCSE (**Students' and Teachers' Conceptions** and Science Education) | Database with about 8400 papers on students' and teachers' preconceptions and misconceptions within different areas of science |
| Cooperative learning<br>https://www.context.org/iclib/ic18/johnson/ | **Cooperative learning: Two heads learn better than one.** | Useful website about cooperative learning; gives the basic definition of cooperative learning and how to structure cooperative interaction |
| Global Learning and Observations to Benefit the Environment<br>www.globe.gov | **The GLOBE Program,** A world-wide Science and Education Program. | Useful world-wide website on ideas of activity-based science teaching programs related to ecology and environment. |

*The links are active on June 29th, 2023.



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International Centre for STEM Education

MOST
Meaningful Open Schooling Connects Schools To Communities

# PART 2:

# Exemplary Science Materials

## Introduction

MOST introduced School-Community-Projects (SCPs) and showed how such projects can serve as a purposeful implementation instrument for Open Schooling. During the MOST project each partner country implemented several SCPs (our definition of an SCP is given in the box below and is illustrated in Figure 1). The projects were conducted in two rounds, first round from spring 2021 until spring 2022, and second round from spring 2022 until spring 2023. In total, 672 SCPs were conducted across 10 countries and in total 78 974 participants were involved. 315 SCPs took place in primary schools, 343 in secondary schools and 14 in kindergarten. The SCPs represented a large variety of projects and lasted from 1 day to more than 6 months. In this part of the document, we present a collection of six exemplary SCPs from each country, 3 per round.

**What is a School-Community-Project (SCP)?**

An SCP is a cooperation between students and their community. In an SCP, students and their teachers collaborate with members of the community: Families, science education providers, citizens, businesses, etc. They join together to work on an environmentally relevant issue that directly affects their community. The size of an SCP depends on how big the school and community are and the number of people who express interest in participating.

The aim of these projects is for students and citizens to work together scientifically in order to develop regionally feasible solution approaches. The acquired knowledge will then be delivered to the community. The sharing of results can be accomplished via short video clips, pictures, posters, flyers, newspaper articles, etc.

For the MOST project we defined one SCP as a group of students working on their own research question/problem, with their own community members. The number of students and community members per SCP is flexible. Each SCP must have a clear and distinct topic, and it must be considered a school community, because there are specific community members involved (specific for this SCP).

In MOST, we focused on the environmental topics waste and energy management as overarching themes for the SCPs. Some projects had a more general focus on sustainability. These issues are of pressing urgency, show the relevance of science for all involved and evidently raise the interest of people around the world and in particular young people. Of the 672 conducted SCPs, 369 were within waste management, 174 within energy management and 129 within sustainability in general. The exemplary SCPs given in Part 2 are illustrative examples of these topics.

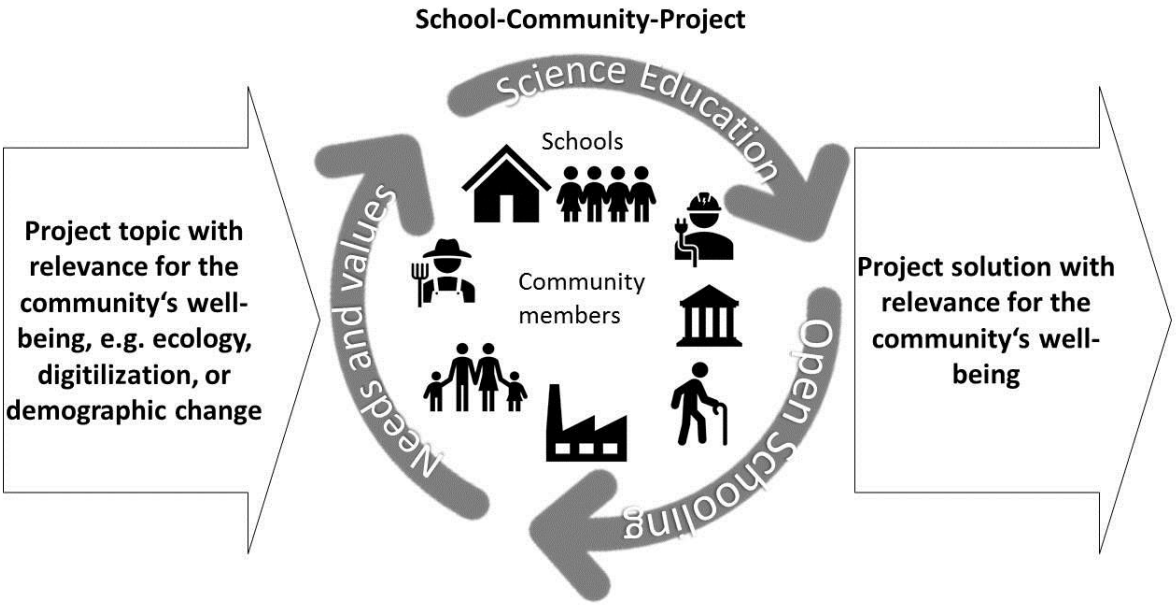



Figure 1. School-Community-Project (SCP)

Part 2 is targeted to SCP leaders, and anybody interested to start, conduct or be inspired by SCPs. The examples presented in Part 2 show the diversity of SCPs in relation to school levels, age groups, duration, topics, students' products, outcomes, solutions and dissemination. The presented SCPs are considered exemplary because they have been impactful to students/schools/community members/the local community, they included a range of external actors outside school (e.g., members from business/industry, policy, non-formal education providers, wider society), they used authentic and socially relevant contexts and topics, were student-centered and inclusive for girls.

Exemplary SCPs are published online at the international MOST website (under the heading SCPs): https://icse.eu/international-projects/most/

For supporting measures on how to set up and run an SCP, please see MOST Deliverable *D3.1 Manual to plan and perform School Cooperation Projects*. D3.1 includes instructions for schools on how to organize SCPs. For an overview of the conducted SCPs in the MOST project, please see MOST Deliverable *D4.1 European report on the solutions found in the School-Community-Projects*. D4.1 reports on numbers, solutions found, issues tackled, and lessons learnt, and shows how SCPs can contribute to responsible research and innovation.

## Austria

### Open schooling – open community garden

The problem arose within the biology class when it was discussed how much waste is produced just by preparing a single meal. In a further step, the discussion led to different length supply chains and their carbon footprint. To create awareness of how much resources it takes to grow fruits and vegetables to produce just one meal and how much waste is saved in the process, HLWest's 3rd grade class began planning their own garden bed as part of their project class.

The goal was to save resources, avoid waste, reduce their carbon footprint, and provide their own school kitchen with fresh fruits and vegetables. Just before the class started the project, information came about the MOST project. The Open Schooling character gave the students the idea to bring the awareness and knowledge also to the community and ask community members for their know-how. A visit and joint co-creation workshop in the university garden of the University of Innsbruck made it clear that working together has many advantages. In addition to the work in the holiday season, the bed can be cared for across classes and for many years. Also, the school, in this case the community garden, develops into a place of learning from and with each other. After some interested community members were found with the help of the association "Dein Nachbar Lohbach" and the transfer office of the University of Innsbruck, the project started. In order to facilitate communication among each other, a joint group was created via Whatsapp, in which those involved could inform each other about news and activities.

Before the start, the area on which the bed should be placed had to be cleared first, because the place was very overgrown. The students then considered together with the community members how to make the soil as fertile as possible. In addition, they already considered what should be planted, what needs to be harvested when, and many other considerations. In discussions and through experimentation, the children have learned, for example, that plants have different nutrient requirements for the soil. Once these considerations had been made and the beds prepared accordingly, it was a matter of finding sponsors for the plants. To do this, the team split up. One group was responsible for acquiring sponsors, another for the work in the garden, and still others took care of theoretical aspects such as the planting plan. Fortunately, a sponsor was found who provided various seeds and plants for the bed.

Regular meetings and the possibility of exchange through the group allowed a smooth harvest in the summer. Since a certain expertise has also been developed for fall and winter vegetables over the weeks of working together, various lettuces and cabbages were spread.
By gardening together, the project has brought the community and school closer together and facilitated collaborative learning. In addition, food awareness increased and the amount of waste produced was drastically reduced as the school kitchen was now able to access the vegetables from the patch. In the meantime, the project has entered a second phase and the garden could be enlarged. Based on the plans of our colleagues, we thought about the implementation of our

community garden. The most important aspect in our eyes was that the beds are also cared for and cared for in the summer months and during the holidays. For this reason, we have started to acquire interested fellow citizens for our projects. We met with them once after our SCP Leader made an appointment. Here, too, the University of Innsbruck again supported us. Together we have now drawn up a plan that is beneficial for everyone.
To disseminate our idea we used the following channels: Newspaper "Westwind", schoolhomepage, yearbook of HLWest.

**Not broken just bend, making new out of old – a creative bike repair shop**

We all know that riding a bike is more environmentally friendly than driving a car. There's basically no air pollution, there are no non-renewable fuels burned, it reduces the "parking problem" and is also better for our own health. But what should we do if our bike breaks? How can we repair our bike in an environment friendly way? And what everyday things could we use to repair our broken bikes? Are there more creative ways to repair broken things?

Those were some of the questions posed by pupils of a class with a robotics focus from secondary school in Wattens. Together with Werkstätte Wattens we are able to introduce them to a group of artists from Vienna, who actually address the above mentioned topics in a very creative and artistic way.

The youths were able to first enjoy a workshop, that started off with an introduction, a quiz as well as some impulses that addressed and fostered the kids' problem solving competences before learning and exploring the possibilities of repairing bikes. Old and damaged bikes were not only taken apart and put back together, repaired by replacing the parts that were broken from other bikes but also in more creative ways: Parts from scooters, like handlebars, were used to repair, big wheels on small bikes and vice versa. A very special highlight was when toys were taken apart, and the pupils were allowed to braze and solder (under supervision and with support) to repair bikes and toys in even more creative ways.

After the workshop – that took part during school time – the pupils returned together with family and friends to work on their own projects and broken tools.

This SCP has been an absolute success with everyone involved. It is a great example of how to open schooling could work. The creative approach of the experts led to very enthusiastic pupil involvement but also community involvement. It showed the ways of the youth to repair broken things with slightly out-of-the-box thinking, encouraged them to repair and reuse instead of buying new, and gave them tools to do so.

In this case, we were able to rely on a long-standing partner of Klasse! forschung "Werkstätte Wattens", who had the expertise needed for the questions posed. The teacher was very open to impulses, and the youths were more than happy to accept challenges. They were very grateful to

still be able to get out of the school, as another lockdown was dooming due to the pandemic situation in Austria. We were once more reminded, that the motivation of teachers, pupils, and experts has been there, to have successful SCPS.

**How to reduce waste**

The research question arose as the student knew exactly what happened to the wastewater. The project was supplemented by the question of how packaging waste can be reduced when shopping.

With the support of the association Klasse! forschung, the students were able to use different materials to research how a sewage treatment plant works. Experts from the University of Innsbruck have agreed to support the project as community members by providing various substances and discussing with the students how and with which materials various substances can be filtered out of the wastewater. For this purpose, water was polluted with oil, dissolved substances, and coarse substances.

The regional problem leading to this attempt is that many people have no idea where their sewage goes, how it is cleaned, and what goes down the drain.

The different levels of contamination in the wastewater pose enormous problems for sewage treatment plants, which is why the school class also became aware that greater awareness also needs to be created in the community. In addition to dissolved substances and oils, microplastics, in particular, are a major hazard in wastewater.

To draw attention to consumer behavior and the problems of plastic waste as a first step, the students conducted a survey and a short interview in front of the local supermarket. Since they often got the answer that there were no alternatives to plastic packaging, they started a self-experiment. The students tried to shop for a meal together without producing plastic waste.

The next step was to pay attention to regionality and seasonality. Since the project took place in the middle of the lockdown, the families of the students and the boarding school acted as community members in this part. Together they thought about how to shop regionally and seasonally.

For us, this project is considered a best practice project, because in the middle of a global pandemic we managed to implement a holistic sustainability project with an open schooling approach together with the school, teachers, and community members, in which stakeholders from different areas come into contact and exchange information came. The results of the students of the project are summarized:

1. Do not pollute wastewater unnecessarily, for example with grease residues.
2. Expired medications and food scraps do not belong in wastewater.
3. Look for sustainable packaging and avoid plastic packaging when you buy food.

**Energy Scouts**

The Energy Scouts was a idea to acquire students who were willing to participate in the MOST project. We describe the project idea as a whole because every single project had a important part of the success of this overarching project idea, we want to present here.

The idea of the SCPs around the overarching topic "energy" arised in a brainstorming session between the MOST partners Innsbruck. Ulrike Umshaus from "Energieagentur Tirol" started working out a concept and a framework which made it possible to integrate vocational schools into the MOST project. To give the students a perfect frame to carry out their project ideas, we decided to cooperate with the Chamber of Labour Tirol, to get contacts to companys and have the possibility to set up a certificate. Together we organised a Launch Workshop for students to inform about the possibilities of the MOST project and communicate the idea of MOST.

The Launch workshop introduced into the energy topic. Beside the students, we invited also experts from different fields, to bring them together with the students. The Launch workshop resulted in teambuilding and co-creation sessions which led to inspiring talks about sustainability and the need of alternative energy, possibilities of energy saving and so on. The participating students were thinking of ideas of projects, they can carry out together and together with their apprentice company. In weekly sessions over 3 months, the students met each other, talked about their findings and lessons learned.

As the overarching topic is energy, the themes and issues, the students tackled were all characterised by a strong connection to the energy topic. The close collaboration with the participating stakeholders made it possible to really open up school, to carry out School-Community-Projects. As an example we want to present a project, which was carried out in cooperation with a local car dealer. The students where thinking of how to reduce the carbon footprint. And came up with the idea to lend bikes and e-scooter instead of cars while the cars are in the repair shop for a few hours. He found out that, the customers mostly just drive into the city to go shopping, while waiting until their own car is fixed. And so the offer of bikes and e-scooter was successful in many cases and saved carbon dioxid. Other projects calculated on how they can improve the efficiency of the machines in their company.

The dessimination was made on several levels. At the end of the project we carried out a MOST-Energy Fair, where the students presented their findings to a broad audience of stakeholder from different areas with short presentations. This fair ended also in a broad discussion between the students and the companys who were present. In addition, a short video about the idea of the project was produced and can be found here.


The projects also attracted attention of local newspapers, who were willing to report about the successful projects. An example can be found here.

In addition, the project was submitted for the sustainability award of the Forum Umweltbildung (part of the Austrian Ministery of Climate Change) and won a price in the category of “cooperation”. A Report can be found here.

Beside this, a lot of companys were informed about the successful projects which led to positive synergy effects, which became visible in the requests and interest shown in the second round of SCPs.

**Weltacker and Essen findet Stadt**

The whole world on just one acre of 2000m$^2$ – How is it possible to feed the always-rising population of our world? This is a question, students of a lower secondary class raised on a first meeting with the MOST team. We than connected them with the feld:schafft, who are participating in the project of having a “Weltacker” in Innsbruck. There, on 2000m$^2$ everything is cultivated what grows on the acres of our world. To give the students the chance to work on their own projects, the whole project started with the Invite stage, according to the INCREASE trail map of the Manual.

So the students invited some experts to the project and started with a co creation process. Afterwards the students found themselves in small groups and discussed, how it is possible, that everyone on our planet can have the same access to nutrition and what are the existing problems right now.

Together with experts they calculated the carbon footprint of different dishes and it became clear, that the range between different meals is immense. The conclusion was, that just single adaptions can have a big impact. What was really special at this SCP, a lot of different questions related to the overarching topic of sustainability came up. So another point was the question on how to reduce waste. Plastic waste of packaging as well as foodwaste?

The students decided to search for a place to set up raised beds. With the help of their SCP leader and the MOST advisor they again found stakeholder who were willing to participate and a place,

which is not far from school and also accessible for community member. The participants were interested community members and a elderly home which is close to the school.

Luckily we found a place, where already existing raised beds were standing (see picture). But the beds were old and in it a lot of undefined herbs were growing. So the students organized a clean up day. The community garden is on a backside of a church, so that also the church was interested in having a clean backyard. So together with the community, the students cleaned the beds and set them up for the rest of the summer. As the beds are also accessible in the afternoon, the students came in touch with different stakeholders and interested persons and both were working together. The raised beds are the answer of the question, on how we can reduce both, foodwaste and plastic waste.

The Weltacker project was part of our MOST-Bike fair, where we advertised a “bike-trip” through Innsbruck, connecting all MOST projects related to the topic of community garden, raised beds, greening of the schoolyard and so on. Together with a couple of community members and local politicians, we drove around Innsbruck, where the SCP leaders presented their project on different stations. The project was also disseminated via the school homepage which led to synergy effects and attracted other schools, to also take part in the MOST project.

**Green Event Waldorfschule Innsbruck**

The Waldorfschule Innbsruck became aware of the project because of our successful community projects from the first round of SCPs. A first initial meeting between the MOST team Innsbruck and some teacher from the Waldorfschule led to a brainstorming about what is possible and how School Community Projects can be carried out in the given framework of the school.

Back in school, the students begun brainstorming about possible projects, therefore they observed the everyday life in school and became aware of some problems concerning waste topic issues. Together they discussed on whom to involve in the community project with the result, that especially the family members and the neighborhood close by were integrated in the project. It shows a different approach as seen in the energy scout project, which is a reason, why we want to list this project as one of our best practice examples, as well.

The decision made, on what project to carry out, the students started to think of how to carry out the project. Observing their classmates in the lunch breaks, they recognized, that a lot of the students uses plastic bottles or lunch, which is wrapped up in plastic. So they decided to organize plastic free lunch to share their knowledge with the classmates. Since then, every Friday there is a plastic free lunch in the school, with everyone participating.

In several meetings they were thinking about what they can do and how they can find a solution. In the ende the solution found was to buy glass bottles, which can be refilled again and again. The

remaining question was, what to serve the classmates. It should be healthy, with a low carbon foodprint and of course plastic free packed. The students decided to ask the local fruit supplier for support. Willing to participate, he provided fruit and vegetables for the project. To keep the carbon footprint as small as possible they searched for reusable kitchen machines to work on their smoothies.

The dissemination strategy was quite impressive in this case. Beside drawing a poster, which is in the school now, we received social media posts on facebook, where the project MOST was introduced and the School community project was presented as well. In addition, the students organized to participate on a local Christmas market, where they presented their idea and results and sold plasticfree drinks. In this case the students played a big part as multiplicators of the MOST idea and sustainable acting.

## Czech Republic

### Let's take it unwrapped!

In the context of the so-called circular economy, there is talk of a hierarchy of waste management. Within this hierarchy, it is best to prevent the generation of waste altogether. The question is where waste can be saved at the outset. In the production process, we as ordinary citizens can hardly influence this, but as individuals we also have the opportunity to do something about it. For example, by " let's take it unwrapped! ". In this context, the following questions may be offered to the pupils: Which types of materials are used to make the packaging that becomes waste in your family? Where to get more detailed information, i.e. not only is the packaging made of paper, plastic or metal? How much packaging waste does the family, school produce in a certain period (day, week)? Is it possible to estimate, based on your own findings, the amount of packaging waste produced by, for example, your municipality (community related to your school)? Does the consumption of packaging materials depend on the way things are acquired, e.g. purchased and/or delivered? On the basis of this initiation, several SCPs (School-Community Project) with different focuses on packaging and packaging technologies have been carried out in several schools cooperating with the Czech MOST project team (Faculty of Education Charles University and Centre of Ecological Education SEVER).

One example is the "Without packaging" project day carried out in an elementary school by ninth graders. The pupils, initiated by their teacher, carried out a set of activities including experimental activities on the topic of plastics, created mind maps and concept clouds from their findings, and consulted their findings with representatives of company “Bezobalu” in the framework of their lecture "Zero Waste". The final part of the project day was workshops on plastic packaging artefacts and bags, where interesting products were created from waste packaging materials as well as decorated linen bags for multi-purpose use.


From a presentation and discussion on "Zero Waste" with “Bezobalu” company representatives

Artefacts from waste packaging materials


Authentic outputs of the project day "Without packaging" - "personalized" linen bags

**Recycling of used cooking oils**

How to focus to waste prevention in school canteen and at home? What means prevention of fat floes? These questions were formulated at the beginning of the SCP worked with research question: how to ecologically dispose of used oil and fat in the kitchen not only in households, but also in school and other canteens or catering facilities. Participants at the school level were 9th grade elementary school students and teachers of chemical and science practice, school canteen managers and experts from oil processing companies. Valued outcomes students obtained from activities: to recognize how fats and oils spilled into the sewer clog the pipes, create so-called sewer grease covers and decommission the sewage pumps. In lab activities and discussions with expert students recognized different approaches, how to elaborate of oil waste: soak used oils in napkins and throw

them in the mixed waste, pour used oils into PET bottles and place them in containers for used oils or collection bins, conclude co-operation with a company which takes oils and processes them further (produces from which biofuel). They prepared different dissemination activities: introduction of the pupil project to pupils at school, parents and the general public at the traditional event "Spring Day", finding out how used oils are further processed (what is their recycling), preparation and implementation of a school experiment on the properties of biofuels and the composition of fats and oils, organization of a survey at school and with the public on the question: "How do they get rid of cooking oil at home".


Cooperation between school canteen and company Bilit in used oil waste


Monitoring of “used oil bins” in the city

**To live in green**

After an agreement with the local government, the pupils focused on supporting greenery in the village. Pupils consulted with the public administration of local greenery about how to plant trees. School arboretum was established, which is open to the public. Students worked on solving of main problem: improving the environment in the village through planting trees. Participants were at school level students from lower secondary school and their teachers, local government, Mirákulum Park (production of signs) and janitor. Most of the preparation work took place in online environment. Pupils searched for the pros and cons of the city, mapped safe and dangerous places. Pupils met with the deputy mayor and the mayor, who took the pupils through the local cycle paths. The pupils handed over the results of the city's analysis to the mayor and then discussed possible project activities. After the discussion, the students have chosen the activity of planting greenery around the school and the subsequent creation of an arboretum. As part of the lesson, students identified trees around the school. Then the class approached the local green authorities and consulted with them planting trees. Pupils planted trees around the school and also planted a new fruit alley. From the 70 trees, the students chose 20 for whom we wanted to create placards. The janitor helped with their placement then. Pupils created a promotional leaflet for the grand opening of the arboretum. The arboretum was inaugurated at the end.

As next valued outcomes we can count created map of the city's dangerous places in preparation phase. Pupils met with local government representatives to present their findings from the city's analysis. Pupils tried to present their ideas to adults and representatives of the community. Pupils learned about trees around the school, about planting trees and learned to plant a tree. Pupils developed problem-solving competencies, communicative, social, civic and work competencies during the project. From SCP “Arboretum” realisation:

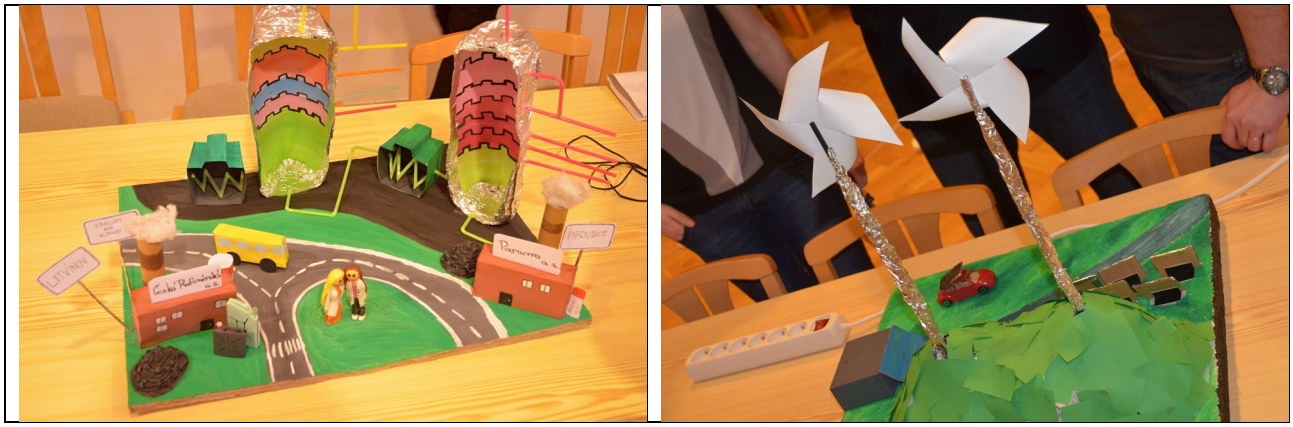


**Energy Sources and Fossil Fuels. How did it start and how to go on?**

First, upper secondary school students build the knowledge on what type of sources (renewable and non-renewable) are used in everyday life and what type of sources prevail in the everyday use of its families, schools and what energy is used in cities. The students, in communication with teachers, parents and municipal representatives, became aware of the importance energy resources for and understand that most energy is used to heat and light residential and commercial buildings; transport and industry follow as the second and third greatest consumers of energy. They also get the information about the energy sources used on the local level and get the information about its impacts on the environment.

The students were asked to represent in the form of a real 3D model the different phases and forms of obtaining and using energy resources. The main goal was to suggest possible solutions for their community in terms of effective use of energy and changing the non-renewable to renewable resources. In order to achieve the goal, students need to gather data about the energy sources and energy mix (share of renewable and non-renewable energy) in their city.

As might be seen on pictures below, the students developed several models portraying different types of energy sources, their production method and use. Using these models the students discussed with the local community what impacts different sources during the production and by use have on the natural environment. Moreover, using the models enabled the public to show the sources production facilities (e.g., pumps, pumping units, compressors, generators, gas flares, treaters, separators, storage tanks, and pits) and area needs to be used for the energy production (land use was discussed). Finally, students share their thoughts about the energy mix in the city and proposed several ways how to change current sources to the more sustainable one.



**Bags in Woods**

As part of the project, lower secondary school students decided to respond to the problem of the amount of garbage in nature. Their aim was to reduce the amount of litter in the suburban forest and encourage the local community to clean up. That's why they decided to make wooden boxes with garbage bags. Every visitor of the forest can take a bag and collect garbage on the walk, which they then put in a designated place.

The main output is several wooden boxes - trash cans, which the students created themselves from the project to the final work with wood. In addition, the students created a bulletin board with information about the project, posters, information leaflets, a photo book about their journey through the project and a promotional article. They also organized an information campaign for the public - they had a stand with leaflets on the square and explained the whole event to passers-by.

A project team worked on the project, and other elementary school students and older children from kindergarten joined in at various stages. They cooperated with the city management (mainly the deputy mayor), the city's press spokesperson, representatives of the forest administration, experts - carpenters, parents (borrowing tools, participating in a voluntary work, helping to transport mailboxes to the forest) and the whole community (sharing opinions and suggestions regarding the project, participating on the voluntary work, use of waste containers).

The children implemented the program as part of their lessons and in their free time. They used skills and knowledge across subjects to implement the project. Pupils learned more about sustainability, became more aware of local problems, began to perceive their surroundings differently and gained the important experience that they can do something to change around them. Pupils perceive a shift in presentation and dealing with people as very important. They gained first experience in communication with the city management or other "decision-makers" and experts, they also had contact with the general public. For most of them, it was an exit from the comfort zone, they overcame stage fright and gained more self-confidence. Another area where there was a huge learning curve for them was woodworking. They got better at designing and planning, learned how to operate different tools and learned a lot about the woodworking process. The pupils

themselves say that thanks to the project they have learned a lot in the field of carpentry, but much more in terms of communication, cooperation, organization of work and implementation of their own activities.

**Christmas without palm oil**

Lover secondary school students focused on raising awareness about palm oil at the school and village level (awareness of the impact of their own consumer behavior). The students first found out basic information about palm oil and the destruction of forests (the reservoir of biodiversity, sink for carbon dioxide – one of the products of energy consumption and measure against soil erosion). They defined goals related to the reduction of palm oil consumption, thought about which activities would lead to the fulfillment of the goal, divided the roles among themselves and focused on the greatest possible impact of the project - that is, where in the public sector this idea (Christmas without palm oil) can be promoted and implement through education and practical implementation.

They also thought about how to involve the public, where and what products to sell, divided the tasks and worked out the budget for the event. They informed the municipal council about the project. They made dried apples, soaps and Christmas decorations (several classes and many school teachers participated, but also some parents). The students also presented the project to managers of local action groups (Local Agenda 21). During the lighting of the Christmas tree in the village, the

pupils had their own stand where they handed out leaflets, spoke to interested members of the public about the effects of using palm oil and sold self-made products (dried apples, soaps and Christmas decorations). The citizens of the village decided to support the project with an additional financial sum. The students then donated the entire proceeds to nature conservation. Pupils inform about the entire project on the school's website and also in the local newsletter. The pupils have a very good feeling not only that they helped nature with their gift, but also that they were able to spread the idea of responsible consumer behaviour and that the adults listened to them and significantly supported them. They also tried and improved various skills, e.g. budget planning, cooperation with classmates, teachers and other adults, making products, selling products, promoting their project, communicating with adults (with the public and decision makers).

## Germany

### Avoiding litter at our school - We'll tackle it.

This project took place at a secondary school in Freiburg and focuses on waste reduction and management. The project's trigger was the increased amount of rubbish at school that had become extremely inflationary over the last few years. In addition, packaging was not disposed of properly which lead to an enormous pollution of the schoolyard, which had also been noticed by some pupils. What was special about the participants was the following fact: The proportion of migrants and people from lower social classes at the school is over 50%, which means that teachers have a special educational mission to cover issues parents might not necessarily consider and raise the students' awareness for such problems. For this reason, the SCP participants decided to collectively research waste management at schools and come up with concrete solutions for their own school and improve the situation themselves. That is why they did not only name the project "Avoiding litter at our school" but also included the motto "We'll tackle it" to outline a clear focus on solutions. They appreciated the opportunity to find solutions to their own real-life problems they had to face every day and the students were quite passionate and emotional about that - instead of being told by teachers or parents what to do.
Amongst the solutions were the advice on how to separate waste, how to avoid waste and why it is important to use the bins provided at the school yard (and in general) or to use more sustainable alternatives instead of plastic bottles and snacks wrapped in plastic or aluminium foil. To make the solutions they found accessible to others beyond the projects' participants, they decided to invite a professional film team from a university with media focus. Together (i.e. collaboratively as equal partners) they developed a script, rehearsed and finally shot the scenes and did the cutting for the film. It was also interesting that the issues addressed and the message of the film have changed during the process: After a while, more and more negative consequences of plastic were discussed and included in the script, such as littered beaches, dying animals that had eaten plastic and huge mountains of rubbish in Asia. The co-creational process worked really well: everybody in the team was open to script ideas and suggestions and the teachers as well as the film team accepted their role as equal project participants. In terms of technical support, some students were even experienced in cutting programmes or filming techniques and could also play the expert role. The final result was shown at the project's school in all the classes, it is featured on its website and also the MOST website to achieve a higher and more sustainable educational impact. This element of science communication was also special to the project and made it a great success.

### Fast fashion

This secondary school in Freiburg focused on sustainable aspects and waste reduction related to fashion. It was a mixed-age group, because it was not a regular class, but a school club focusing on environmental protection and climate change. Having decided on their topic of interest, as a kick off, they watched a film on fast and super fast fashion to raise the general awareness of all

participants, which was followed by a vibrant discussion on the issues addressed. After further research, together they tried to come up with an idea to solve the problem in their own community: They organized a campaign covering all kinds of information on sustainable clothing and how to avoid or replace fast fashion and upcycle it as well as useful apps to get more insights into the topic. In addition to that, the project offered an overview on eco-friendly and sustainable labels and brands. As a second step, to put these ideas into practice and set an example as role models for the whole (school) community, they also wanted to initiate clothes swaps and a flea market. All pieces of information and solutions found were disseminated through the club's Instagram channel, posters in a public area at school as well as the school's newsletter to reach a wider public. The third step was supposed to be a hands-on activity: They founded a sewing club that uses old clothes and upcycles them into all kinds of things. The group sought inspiration from a regional boutique specializing in upcycling products.

Throughout the whole process, the group was accompanied by members from a second-hand store, parents and additional community members supporting the sewing club.
This SCP is a success story, because the participants tried to view the problem from many different angles and came up with multiple solutions for the (school) community. Moreover, in terms of dissemination, they have reached a huge audience and, being a school club, represent a highly sustainable project which will probably focus on and educate others on environmental issues long-term, i.e. it might also create impact beyond MOST's lifetime, with this SCP being the symbolic initial ignition.

**"Earth, why do you look so sick? - We want to help you!"**

This project took place at a primary school in a village close to Freiburg. It was initiated by a university student and a teacher from that primary school.
They chose the topic of environmental protection and sustainability, because it concerns everyone, but especially the young people in our society. They felt that the kids were increasingly worried about the environment as a consequence of what they had heard at school, from their parents or the media and their teacher felt the need to do something to make them and their worries feel heard and taken seriously. Consequently, together with their students from Year 4 and external participants they designed a MOST project for this purpose.
The activities were given the title "Earth, why do you look so sick? - We want to help you!" to include the students' worries, but also focus on a common goal to find a solution to their (and the society's) problems.
During these intensive five weeks, the class discovered how waste separation and recycling work, what the community is already doing to protect the environment, and how much CO2, for example, is released into the air by driving. But above all, they all learned how these aspects harm the environment and drive global warming. To actively counteract this themselves, the class and their teacher met with the local forester and the village's mayor to work out a plan together, because they felt that it was important to tackle the problem with the help of an expert on climate change as well

as a representative of the local community. They came up with some ideas on how to individually help the environment, but also on how to create a symbol of their project:
That is why at the end of the project they planted a tree together at a lake close by. This tree now filters the air and reminds the children again and again how they can achieve great things even with small efforts and make the earth whole again.

**Balcony power plants and beyond**

The SCP members from Denzlingen Secondary school tried to tackle the problem of what to do with old solar modules that aren't used any more. They focused on the following questions:
"How do solar systems work and what happens with used solar systems?" as well as "How can old solar systems be reused?"

They found out that older solar modules are disposed of when they become less powerful over time and are replaced with new, more powerful modules. However, the old solar modules can still be put to good use. The students made it their goal to convert these solar modules into a balcony power system and thus feed environmentally friendly and sustainable electricity into their school system in order to make the school more eco-friendly.

For their project, they founded a sustainability club at the school. The two teachers involved all the members as well as different natural Science classes and personally addressed regional experts as well as representatives from the community to establish an open schooling atmosphere. It was a mixed age group that met with external experts on a weekly basis.

Together with parents, people from a sustainable farming project and two solar companies, they came up with the idea to recycle those solar power modules and turn them into balcony power plants. After that they planned to use the power for different purposes.

How did they work?
When the project idea was finalized, there were many things to clarify in advance:
For installations of a balcony power plant on the school building, they had to talk to the school management and the municipality as well as the energy supplier to obtain approval.
After research about solar panels, a consultation with the school's janitors about possible installation locations was necessary.
This was followed by a consultation with the responsible building electrician on the installation of the power socket.

After these first steps, they could finally start the project. They did some more research about solar panels and exchanged ideas with the experts. Then they did technical drawings and created a design of the balcony power plants and at the same time did some research on how to build them and figured out ideal locations. After collecting old modules, in their natural Science and Technology

classes, they added new cable routing, replaced cables and installed everything. In doing so, they made the old solar power modules ready-to-use again.

Together, they also came up with many ideas on their future use. They wanted to combine the new source of energy with an agricultural project: So they established sustainable gardening and planted all kinds of vegetables in their school garden. They received a construction trailer from the local community and installed a solar system o its roof. It is now used as a charging station for garden equipment and lights.

Future applications of the power units, they will be developing a farm bot which will independently plant and care for raised beds. It is to be powered exclusively by solar electricity from the converted solar cells. For this purpose, an electricity storage system still has to be created.
Moreover, they will design an outdoor classroom and use the power in order to fuel the overall school's power system with power from the balcony power plant as much as possible.

To sum up, the solutions they found were manifold: They found a way to recycle and reuse old solar modules and avoid their waste. Moreover, they produced environmentally friendly power for their gardening project and will even make greater use of it in the future by at least partly fueling the school's energy system with that power.

Eventually, they disseminated their results through the publishing of an article in the local newspaper, informed the whole school community about it through their website and became an inspiration for projects in other regions by spreading their ideas through the MOST section on the ICSE website.

It is a success story because they basically use waste materials and reuse them for various purposes. It is also a sustainable project that will continue working on eco-friendly energy beyond the projects lifetime, because the SCP participants met in an extra-curricular setting which can sometimes be helpful because participants are highly motivated, external participants can sometimes attend the meetings more easily than in the mornings and the project is not restricted to a school year, but work can go beyond that.

**Effects of packaging on the environment**

The aim of this project was to take a closer look at what impact paper and plastic packaging waste have on the environment. The underlaying research questions were: What does packaging have to do with climate change? What can be done about the growing mountains of waste generated by online shopping and takeaway food? Is packaging made from renewable resources the solution?
Never has there been more waste that is collected, separated and recycled in Germany - yet the mountains of waste, especially packaging waste, are growing. How can plastic and packaging waste

be reduced to protect the environment? How can young people be encouraged to develop their own messages and ideas for a world free of packaging waste and implement them using media?

The project involved all kinds of people: three female teachers, a group of vocational students, occasionally parents, members from several companies and when it comes to their presence at bigger events and the study they initiated, they reached out to a large audience and included about 10.000 households in their survey.
To involve several members from companies was not difficult, because each student from a vocational school is automatically part of a company and can easily reach out to colleagues for that. To include the broader community, parents were involved and they reached out to community members through surveys or events organized with the help of and for the public and organisations like Greenpeace, HEI like the TU Stuttgart etc..

The project was divided into two phases:

Phase 1: Raising the awareness for packaging: Through research the participants learned about the global Sustainable Development Goals (SDGs) and gathered ideas and action items on how they can use the SDGs to engage. Using materials provided, they worked on future-oriented packaging materials from the packaging industry. Afterwards, they researched what has already been done in the industry.

Phase 2: Raising the awareness on consumption – packaging – plastic: In consumer trails, the participants used their smartphones to learn new things, reflect on their own consumption behavior, and develop ideas on how they can take action themselves with simple, concrete steps. On the one hand, they dealt with their own consumption behavior as well as with problems and effects of non-sustainable actions with a focus on plastic and packaging.

In addition, they planned activities to promote the solutions, e.g. a Future Day with the motto: “Old boxes rethought” with a hands-on activity at which they informed people at a booth about their apprenticeship profession, on the one hand, and showed packaging recycling from cardboard boxes, on the other hand. Furthermore, a poetry slam about it was be organized.

These solutions were found:
Environmental impact of packaging and paper: The production of virgin fiber paper consumes a lot of energy and water, and toxic chemicals are used that can pollute water bodies. CO2 emissions per ton of paper have fallen by around 36.2% since 1995. Nevertheless, the German paper industry still emitted around 13.8 million tons of CO2 emissions in 2018.
Recycled paper, on the other hand, is less harmful to the environment. This means that waste paper is processed in recycling plants in such a way that new paper is created from it. For this, the recycling industry needs up to 60% less energy and 70% less water compared to virgin paper production. In

the same way, new can be discovered from "old boxes," which the trainees demonstrated on their project day.
Awareness can be raised through paper data collection at school. The data collected can be used to show how much water, wood, energy and CO2 emissions would be saved with certain measures. Also our presence at various events helped.

To summarize dissemination, they tried different measures that proved to be successful: They exchanged ideas with other projects and shared lessons learned. Participants from one group acted as mentors for other groups. They also took part in or organized several events. These were made available on the school website (e.g. Educational cooperation with a "Grenzenlos" activist; certification as a "Grenzenlos" school; presentation and hands-on activities at the MOST fair in Freiburg; Future Day in Neustadt). Moreover, information was spread by emailing the companies about their activities. A stand at the Future Day in Neustadt on July 15 was organized and a press report was published in the local newspaper. Also all activities are visible on ICSE's MOST website. Even a poetry slam about the topic was organized.

The project was a success because they reached a great number of people, so the project had a large impact on the local community and they came up with creative ways to disseminate their findings and increase awareness for the problems.

**Sustainability forum**

The project focused on sustainable nutrition and gardening, because our daily routines and consumption highly affect the climate. Therefore, the following research question was formulated: How can you garden and eat sustainably? The goal was to create a sustainability forum, i.e. to create a network of people sharing the same interests that is represented in an event like a sustainability day to reach out to people, find more to join the good cause and to increase the (school) community's awareness about the issue.

Theodenktnachhaltig is the name of the school's climate club. They reached out to attractive external partners and community members by emails, phone calls or visits and invited them to the forum.
Eventually three teachers, the headmaster, and 40 external participants (parents, a city planner from the Office for Garden and Civil Engineering, members from organizations like one world forum, teachersforfuture or the Eco Institute) joined them.
They researched the topic and came up with the following solutions that have a positive effect:

- Sustainable nutrition can be achieved by growing your own food in a raised bed.
- Raised beds offer the possibility to grow food even without a garden, e.g. on city balconies.
- Own planting supports sustainable consumption.

- It is good to preserve old vegetable and fruit varieties.
- Regional consumption is as important as sustainable consumption.

Together, they came up with interactive and very lively ways to present the topic on a specific day on the school grounds. Their intention was to entertain and inform people in a relaxed atmosphere on a sunny day outside.

What happened at the forum?

- Together with their guests they built a raised bed.
- They cooked meals from sustainable/organic/homegrown vegetables and exchanged recipes and gardening tips over it.
- There were speeches and interactive performances on a stage ("infotainment").
- The schoolyard was full of booths from other climate clubs and regional organisations.
- Outdoor activities like the visualisation of one's carbon footprint through nutrition were offered.
- They offered live bread-baking.

In doing so, they wanted to inspire their audience, but also actively involve them in some hands-on activities they can also do at their homes. Also there was room to network with other actors, parents, teachers and visitors over homemade sustainable snacks and refreshments.

They disseminated their results by articles and a picture documentation on their school as well as on the ICSE website in the MOST section.

It is a success story because they brough together important regional actors for their topic and increased the (school) community's awareness of sustainable nutrition and gardening. Beyond the project, they also created a loose network of several partners who would like to keep cooperating in the future.

## Lithuania

**I sort waste - I protect nature**

School: Druskininkai “Saulė“ basic school

Teacher: Ilveta Eitmantienė, primary

Students age: 6-7 years


Ilveta Eitmantiene’s photo (The parents agree to share their children photo)

Sorting is often seen as a trivial matter, incapable of making a difference to the global climate change problem. But all the world's troubles start with small things that are influenced by the behaviour of each of us. One person can save a hundred trees by sorting their waste, and if their children follow him, the whole forest will remain uncut. The research question of this School Community project: Are we sorting waste correctly and willingly? How do we sort waste correctly?

The 1st grade students participated in the project. They had several meetings with community members, a lecture on waste sorting, educational videos with funny stories about protecting nature, which helped the children to learn how to sort their household waste correctly. We all together thought, what else can we do? Sorting is the first step if we want to live in a clean country, drink unpolluted water and breathe clean air. But it is not enough to be a responsible consumer. We decided to follow three steps rule: reduce packaging -> reuse -> recycle. All the parents and a few grandparents joined the project together with the children.

The students meet representatives of “Edulandas“ company and took part in the education "What secrets does water hide? What would happen if water suddenly disappeared or became unusable?“ In this innovative STEAM-based education, children explored the importance of water in the modern world. In the remote version of the education, children had the opportunity to have their say in virtual votes, the results of which influenced the choices of the characters in the story.

The children were conscientiously involved in the project activities, and we involved all family members. If children are taught the basics of waste sorting from an early age, it becomes a natural thing for them in the future. It is very difficult to forget bad habits, but much easier to develop good ones, which is why learning about the importance of waste sorting from an early age is particularly important.

**Reducing packaging:**

Consumption is growing every day in line with the world's growing population. But our habits are not environmentally friendly either. The more we consume, the more we pollute. The parents with students decided one month follow a few simple tips:

- buy only what you need;
- buy less often, but in larger quantities;
- buy packaging that can be recycled;
- buy goods in packaging that can be replenished (e.g. soap, rechargeable batteries);
- buying environmentally friendly goods (energy-saving light bulbs, items made from recycled materials);
- use less plastic bags - bring your own cloth bag to the shop.

**Reuse:**

A lot of the packaging we buy can start a second life in our homes:

- Plastic shopping bags bought in supermarkets can become rubbish bags at home and paper bags can become wrapping material;
- envelopes can be used for notes, memos;
- glass containers can become containers for all kinds of products;
- newspapers, cardboard packaging can be used as packaging material;
- old clothes at home can become new pillowcases, napkins;
- tyres can be used creatively at home - for example as swings for children;
- wood products can be used as firewood.

**Recycling:**

Every day at home, a significant amount of so-called green waste is generated. For every tonne of such waste that goes to landfill, 300-500 m3 of harmful gases are produced. It is therefore important that such waste is collected and managed separately:

- Composting can be used for garden and garden waste: flower and vegetable scraps, grass clippings, tree leaves, small twigs, poo from domestic animals (rabbits, chickens etc.);

- kitchen waste: vegetable waste, husks, shells, flowers, fruit, coffee and tea grounds;

- It is not advisable to compost weeds with seeds, which may persist in mature compost. Spreading such compost on the soil leads to contamination.

The results of the project have been published on the school's Facebook page, and in the city's weekly newspaper "Mano Druskininkai".

**Where to put used markers?**

School: Vilnius Jesuit high school

Teacher: Eglė Jasutė, mathematics

Students age: 13-14 years

This is a project about decreasing pollution that comes with the use of markers. Our goal is to raise awareness on the mentioned topic and make a difference.

We often use markers in our daily life, especially at school. But there is one big problem – markers aren't refillable. After markers run out of ink, they are usually thrown out without thinking twice. Most of them aren't biodegradable because the reservoir, which holds ink inside of a marker, is made out of polyester, while the body of a marker is made out of plastic. Therefore, it is not possible to recycle a marker as one piece. So, what are some environment-friendly solutions?

First, we made a public poll in which people informed us, what they do with markers that have run out of ink. Afterwards, we came up with a few ideas for reducing pollution caused by markers:

- **Bringing markers back to life.** The process is simple: take a used-up marker and dip it into water. Then wrap it in plastic cover (you can reuse the wrap multiple times) and leave it overnight. The following day, the marker is going to work as brand new. Here's a tutorial on how to do it: https://youtu.be/cx_A1xZG7H4
- **An artsy solution.** It's quite easy to make paint out of old markers: take some old markers and put them in water-filled jars. Then leave it overnight. The following day you are going to

have some lovely watercolour-like paint. Here is a video on how you can do it: https://youtu.be/Y9LWpvjJuyw

- **A correct way to recycle.** There's also a way to recycle markers without harming the environment. All you have to do is take the marker's components apart. Now you can recycle separate parts individually.

Another useful thing to mention is that some companies, like "Crayola", offer marker recycling services. You can send a handful of markers to them and they'll recycle the markers.

In conclusion, even though the problem seems quite tough to solve, there are multiple options to reduce pollution that comes with the use of markers. So, what are you waiting for?


**Pollution of medicines - where to put them??**

School: Vilnius Jesuit high school

Teacher: Jolanta Jaksiene, science

Students age: 10-11 years

Almost all of us have expired and unused medicines in our homes. How to correctly remove outdated medicines from our home? Most people throw away expired or unused medicines in the household trash.

Prof. Viktoras Masevičius of Vilnius university Faculty of Chemistry claims that due to improper sorting of medicines, antibiotics can be found in the landfill and are dangerous for the environment. According to the professor, the breakdown of antibiotics affects the emergence of incurable diseases because of antibiotic-resistant bacteria. In addition, plastic packaging of medical products pollutes the environment. We are able to change that! Return any expired and unused medicines to pharmacy!


Agne Ralyte's comic

5th grade students made the research by investigating what is the correct way to remove expired medicines from their homes. The students listening to a pharmacist who shared information about removal of medicines, and provided numbers and facts. The students found out that in 2020 more than 80 million medicine packaging were sold, it is more than 3000 t medicines. However, only 14 tonnes were returned back to pharmacy. These facts led students to ask community, what people are doing with expired or unused medicine? Students found out that more than half respondents throw away medicines into household trash and haven't realized to do something else.

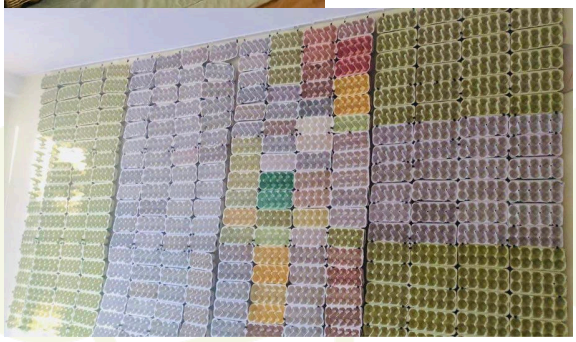
Students decided that social TV, radio or social networks should advertise the returning medicines to pharmacies. People are missing information about harm caused by discarded medicines.

Students made educational video and shared it with community (Pollution of medicine MP4 file).

**Bringing the community together for a noble cause - insulating an internal wall with recycled materials**

Teachers of Vilnius kindergarten "Lakštingala": Dalia Sokolovienė, Svetlana Bystronovskaja, Viktorija Strazdauskienė

In this day and age, when we hear every day about energy savings and initiatives to achieve them, any opportunity to initiate actions and participate in projects is becoming commonplace, and is of great value in finding new opportunities to educate the younger generation. It is particularly important to introduce conceptual values to pre-school children by showing them all the processes. At the beginning of September, we came together in a steering group and came up with some great ideas that we tried to to implement in our institution. One of the ideas, proposed by the pupils' mother, an architect and engineering was to insulate the inside of a wall with recycled materials. The steering group really liked it and supported the idea. What was needed most was the help of the community to collect the necessary amount of material and to insulate the whole wall of the group (the one bordering the field) from the inside, raising the children's awareness of the fact that building quality is the future aspiration of all of us and that it is irresponsible and environmentally irresponsible to "heat the air". We were very surprised to find that corrugated cardboard and egg cartons are excellent thermal insulation materials. Such materials give the walls a better thermal resistance and reduce heating costs. This is all thanks to the efforts of the families of the three groups of pupils in our kindergarten, the commitment of the teachers, assistants and the whole community. It was only after the announcement of a project to collect empty egg cartons (egg trays) that a large amount of this recyclable material came into the groups. 343 egg trays were brought in over 20 days. The cartons were glued and then mounted on on the wall. We recorded everything and analysed the results together with the pupils. The wall of the group was insulated from the inside and the result was not disappointing. The group wall has been given an innovative look and the room warmer.
Both the educational establishment and the home are places where attitudes are developed and shaped, and attitudes, skills and habits. In order to achieve our common goals and make them a success, we had to to collaborate with parents, to involve professionals and experts in their field who shared their ideas, insights and discussions together, we implemented an idea that allowed the children not only to visually creative processes, but also make a strong contribution to their implementation and energy saving. Only a cohesive and active community, which produces a modern citizen who is open-minded about today's problems, who is able to put ideas into practice and show children the importance of sustainable living and benefits. By gaining experience, the child becomes indifferent to nature and to the issues of today's world.



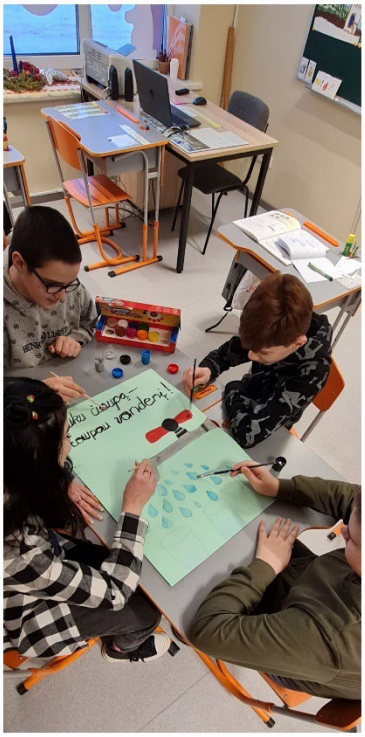
**I'm changing my habits - saving water!**

Teacher of Prienai Revuonos lower secondary school Kristina Nastulevičienė

Reducing daily water consumption can be achieved effortlessly by mobilising the whole community and changing daily habits. The research question is: how can we save water in special education?
During the project period, we brought the whole community together to share the savings "virus": students and teachers, dormitory teachers and caretakers, teaching assistants, cleaners and drivers. We organised community meetings where we divided up activities: for 2 weeks, we monitored water use habits in the kitchen, toilets and washrooms. During the observation discussion, we made saving decisions and spent one month learning new water saving habits. During this time, activities took place in the classrooms: some made water saving reminder stickers, others checked the leakage rate of the toilet cisterns (using coloured water), and others searched for information on water wastage. The "Does the toilet flush?" test showed that 2 out of 9 cisterns tested flush. After informing the school administration, the faulty taps were repaired.
Information and reminders (stickers) on how everyone can save water (in washrooms, toilets, kitchen) were distributed throughout the special education department (2 buildings) to help people to develop a new saving habit.
Classes have produced informative "BLUE PLAYS", which are displayed in the common areas of the special education unit.

We shared the project activities, results and recommendations on the school website. Each student who took part in the project took water saving reminders/stickers home to spread the water saving "virus" to their families.





**The House of the Future**

The teacher of Vilnius Sietuva progymnasium: Snieguolė Bagočienė

How to create a lighting system for a house or apartment, a school, a house that produces more energy than it consumes, and how to connect other sensors, modules, sensors and solar panels in the future house.
Motion and room light sensors linked to switching lights on or off to help save energy. Selection and testing of bulbs in indoor environmental conditions. Implementation of the best solution in the house or apartment. The house is constructed in wood and generates solar electricity to heat water and provide enough electricity for the household.
Water is collected from the roof and used for heating and household needs. A well-designed ventilation system is an important part of a healthy home environment. The CO2 rate indoors is very important for a person's general well-being.
Investigate how much we save on electricity by converting to solar power. How to use less of the normal electricity provided at home, in the apartment or at school. How to reduce waste by turning it into energy.
Meet both at school and remotely via Zoom. The children worked at school. Parents worked at home in some cases. They explained how to implement the tasks in the project.
We've created a house that produces more energy than it consumes. The house is visually based on drawings created by children. Everything will be controlled mainly by Micro:bit computers. The house reacts to sunlight, triggering a variety of sensors.
To make students aware of global issues at school, and to help them learn how to save electricity and land resources. We realised the complexity of the system that has to be put together to produce the house of the future, but beyond that, it will already have all the functions in place. The more of these buildings we have, the cleaner our planet will be.

## Malta

### Improving the environment in our community

This SCP led by the EkoSkola Committee and involving the students of Kerċem Primary school attempted to answer the following questions:

(a) What is the environmental impact of waste in our community?
(b) How can we reduce waste in our community?
(c) How can we embellish our community?

It aimed to:

- sensitize students about the waste problem in the community of Kerċem
- support the Kerċem Local Council in efforts to embellish the community
- propose specific actions to improve the quality of the environment

The project started with a school-wide awareness campaign about the negative impact of waste on the community. This was supported by regular meetings of the EkoSkola Committee with the Kerċem Local Council. The EkoSkola Committee also had meetings with the Bishop and the Minister for Gozo about their concerns about the quality of the environment.

The project culminated with an onsite visit to the Għadira ta' San Raflu at Kerċem during which the students conducted a clean-up of the area.

As a follow up to the clean-up, students submitted a proposal to the Local Council to embellish that area and make it more accessible and attractive for visitors.

The Kerċem Local Council accepted the students' proposal and applied for (and received) funds from the EU to carry out the embellishment project. The application was supported by the Ministry for Gozo.

The Local Council promoted this project (and other EkoSkola initiatives) on their social media networks. The project also featured in the Ministry for Gozo's Facebook page.

### Changing our Ways!

This project involved students of St Benedict College Middle School, Kirkop who are 11-13 years old. They tackled the problem of waste generated and tried to answer the following questions:

(a) How much waste does our school produce?
(b) What are the characteristics of this waste?
(c) Can it be avoided or reused or recycled?
(d) How can these practices be applied to our homes?

The project focused on various waste fractions and aimed to:

- sensitize students about the issues related to the problem of waste
- lead students to identify alternatives and behaviours that effectively address the waste problem
- empower students as change agents in their families and the community

Students participated in the international Mini LitterLess Campaign which raised awareness about the harmful effects of litter in our environment. Students took part in 7 different actions: appreciating the beauty of nature; harmful effects of plastic on animals; harmful effects of invisible pollutants; reducing our consumption to reduce waste; adopting a zero-waste lifestyle; the importance of a joint effort to reduce litter; and a clean-up to pick up any litter that surrounds our school premises. The actions were seen as the primer to spark off efforts on waste reduction. Work then focused on different waste fractions.

Students focused on recycling and upcycling clothes. After learning about the origin of clothes and the positive environmental impact of recycling, upcycling, and donating clothes, and the difference between recycling and reusing clothes, they participated in a craft activity, whereby they upcycled an old t-shirt and made a tote bag out of t-shirt material. The next phase included students sensitizing their families about the issue. This led to families going through their wardrobes and donating old clothes that were placed sorted for recycling or to be sold as second-hand items.
Paper Waste was also targeted to address the large amounts of paper used at school every day. During a class workshop, students learned about the process of making paper and paper recycling. They then identified ways how to reduce paper consumption and symbolically planted a couple of trees in the school grounds to compensate for paper waste.

The school efforts in waste reduction were also presented for the European Week for Waste Reduction 2021.

Most of the solutions proposed focused on waste reduction and on ways of maximizing the use and thus extending the life of products.

The students came up with the following solutions to deal with the problem in their locality:

- More informed use of the national recyclable waste collection scheme.
- Creating awareness about upcycling as an alternative to recycling.

The project's results and suggestions were disseminated throughout the whole school community and beyond through the school's social media platforms.
While working on the project, the school established collaboration links for this and future projects with: (i) Kirkop Local Council for community outreach; (ii) ST Microelectronics – for work with electronic waste; (iii) HSBC Malta for work regarding Climate Action; (iv) Wasteserv for work related

to waste management; and (v) ReFab Textile Recycling for work specifically focused on sustainable use of textiles.

**Investigating a turtle nest site**

School-Community Project (SCP) documentation
SCP leader: Ms Ramona Mercieca

Participating school: Gozo College, Middle School

Students' Age: 11-13 years

Project time frame: Project Year 1

The students of the Gozo College Middle School worked on this project. They investigated the following research questions:
(a) What are the ideal environmental conditions for a successful turtle nest?
(b) Does climate change affect turtle hatchlings?

This investigation started when a loggerhead turtle laid eggs on Ramla Bay in Gozo. This was the first recorded and confirmed nest in Gozo after 70 years and it sparked interest in conservation and marine life. Students measured surface and ground sand temperature from and around nest site, air temperature, humidity and barometric pressure 3 times daily (morning, afternoon, evening) throughout the whole incubation period between June and August.
During site visits the students noticed, on many occasions, that the beach was full of litter especially cigarette butts and microplastics. To back up the educational process and support wildlife, the students took the initiative and organised a beach clean-up event. They teamed up with volunteers from Nature Trust FEE Malta (a local NGO) and the general public.

All data collected was analysed during online meetings.

- Research shows that if a turtle's eggs incubate below 28°C, the turtle hatchlings will be male. If the eggs incubate above 31°C, the hatchlings will be female. Temperatures that fluctuate between the two extremes will produce a mix of male and female baby turtles.
- During the incubation period sand temperature never exceeded 30°C, so most hatchlings were males. Out of 105 eggs, 84 hatched but 2 of them were dead.

Besides lots of cigarette butts, bottle caps, straws and cotton bud sticks, thousands of small pieces of plastic including nurdles were collected from sieving the sand during the beach clean-up.

Most of the students were accompanied by parents and other family members during their data collection sessions. In collaboration with Nature Trust FEE Malta students promoted the Adopt the Turtle Campaign.

The students participated in 2 online meetings with students from the University of Lima. They spoke about their experience and shared the results of their investigation on marine litter and data collected from turtle nest site in Ramla Bay with 1st year General Ecology students attending Universidad Nacional Agraria La Molina in Lima, Peru. The students shared their findings and together they discussed the ideal conditions for a turtle nest to be successful. The project was also submitted and received awards in the International Virtual Science Symposium organized by the GLOBE Programme.

**Environmental Audit of the building housing the office of the Prime Minister**

Students of St Ignatius College Ħandaq Middle School led the audit of the building housing the office of the Prime Minister of Malta. They attempted to answer the following research questions:

(a) How are principles of sustainability implemented at the work place?
(b) How can the wellbeing of employees be safeguarded through sustainable work practices?

The project aimed to help students to:

- explore real-life sustainability issues/dilemmas that challenge the 'textbook' approach
- promote change in the community
- share experiences and suggestions about sustainability issues

A group of six students accompanied by their educators carried out an environmental audit at the Office of the Prime Minister and other areas within Auberge de Castille, including the quarters of Hon. Dr. Carmelo Abela, Minister within the Office of the Prime Minister.
After liaising with the Office staff, two students conducted a reconnaissance visit to the site to familiarize themselves with the place and identify issues that need to be looked into more detail during the actual audit exercise. Together with their teachers they developed a checklist that they will be using during the audit.
On the day of the audit, the students toured and examined the building and audited various areas including: the front offices, the reception area, the Prime Minister's office, the staterooms, the boardrooms, the kitchenettes, the bathrooms, the restrooms, the corridors, the fire exits, the waiting rooms, the terraces and various other facilities. The students also had the opportunity to interview staff members to further understand in which way the existing building design, operations and in-house policies are contributing to a more sustainable lifestyle.

Back at school the students analyzed their observations and compiled an action plan that they presented to the Hon. Dr. Robert Abela (Prime Minister of Malta) and Hon. Dr. Carmelo Abela (Minister within the Office of the Prime Minister) in the presence of their staff. In a year's time the students will once again visit the OPM to verify if any of the recommendations they put forward were taken aboard.

The solutions proposed were grouped under the following categories:

- measures to ensure energy and water conservation
- procedures related to waste management
- measures related to safety
- green procurement
- practices that promote the wellbeing of employees

Besides listing the issues found (organized per areas visited), the Action Plan presented relevant actions that need to be taken to promote sustainable choices and habits.

The event was reported on the Prime Minister's personal FB page, on newspapers, on national TV and on the EkoSkola website.

**Olive Picking**

The school's main concern is food waste and Olive Picking is just one of a string of projects that are all connected to this main theme and to the school organic farm – which was originally a derelict area. Once formed, the organic farm became the hub for initiatives related to healthy eating. Through contacts with various farmers (mostly relatives of the teachers and/or students) students learned agricultural skills and were soon growing their own vegetables and fruits at school. They also decided to sell the produce (for fundraising purposes to maintain the farm) to their teachers and families.

In their efforts to keep the production as organic as possible, the students decided to keep a compost bin which was maintained mainly through garden waste from the farm itself. While collecting garden waste from the garden of the Sisters of St Dorothy convent, students noticed that a large percentage of olives was being wasted. They enquired about this and learned that the community of sisters used to pick the olives themselves to produce olive oil, however they had to discontinue this practice because of their old age. This was what sparked the Olive Picking project.

**Fostering SDG Awareness**

The school administration conducted a questionnaire with staff, parents/guardians and students and discovered a community deficit with issues related to sustainability (as expressed in the SDGs) and consequently on how to make sustainable choices and live sustainable lifestyles. The school initiated

a string of student-led projects under the theme Together for Our Planet of which Fostering SDG Awareness is a component. The overall aim was to facilitate a whole-school approach to learning all the leaners (from KG to Year 6). Besides a general increase in awareness of the SDGs, this SCP included as Priority Targets certain SDGs (i.e., SDGs 11, 12, 13, 14 and 15) in the School's Development Plan and have now become part and parcel of our teaching and learning:

To promote active citizenship skills and 21st century skills amongst the young learners, a cross-curricular approach that integrated various other projects and programmes thus promoting a systemic viewpoint was adopted. Students were encouraged to reflect on their actions and how they can achieve some targets of the Sustainable Development Goals. The school focused on providing a variety of actions aimed at enhancing the children's curiosity and responsibility towards the surroundings through activities that involve their families and consequently the community.

**Towards a Carbon Neutral Future: Our Tree Inventory Project**

The school is situated in Gzira, an urban area in which there is heavy traffic and many buildings. In efforts to improve air quality, the Local Council embarked on a tree inventory exercise in the locality funded by the JUSTNature project, which is a part of the European Commission's (EC) Horizon 2000 programme. The school decided to support this inventory exercise especially because of its 200 trees located in different areas of the school. The tree inventory exercise was conducted in collaboration with the Research Innovation Unit as part of the Gzira Local Council.

All the Grade 7 students (11-and 12-year-olds) participated in the exercise and were divided into small groups, each of which assisted by teachers, Learning Support Educators. Grade 11 students (16-year-olds) together with project officers from the University of Malta and the Eastern Regional Council environmental manager. Each group mapped the trees of different areas of the school.

During this exercise, the students identified each tree using an application called Plantnet or Google Lens and a booklet which illustrated different local tree species. Students then measured the circumference of the trunk to determine the age of the tree. They also took a photo of each tree using a survey reference scale to find the height of the tree and the width and surface area of the tree canopy. All this data was inputted using an app called Map marker and each tree's location was geotagged. All the data collected was sent to the Gzira Local Council for processing.

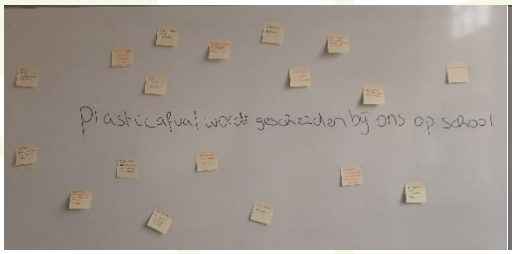
The aim of this exercise was to determine how trees impact the carbon sequestration within the area and the amount of oxygen released through photosynthesis. Moreover, the information collated will assist in determining the temperature change because of the shade provided by the canopy of trees and the natural cooling of the site through transpiration.

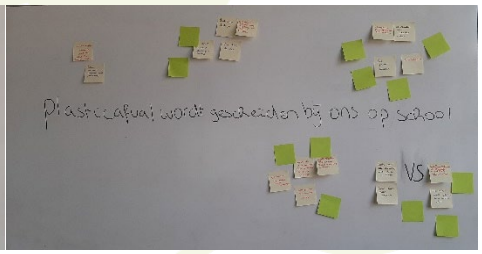
## Netherlands

### NO plastic bottles in school

The first SCP in the Netherlands was carried out by a small group of four enthusiastic secondary school biology students (16-18 years old). Plastics disappearing in the water surrounding the school (canals) was the main underlaying problem the students choose in their brainstorm session. Students were introduced to the problem of microplastics in lessons before the start of this project as part of the regular school curriculum.

We first shared success experiences on sustainable subjects or on collaboration projects, later added a broader view on successes in general according to the process of appreciative inquiry. Students wrote each experience on a sticky note, put these on the whiteboard. Then, students selected the experiences that could contribute to this next project. The students noted that many plastic waste was part of the total amount of regular waste in combination with the fact that our school is not separating their waste. Therefore, the students wanted to focus on how to reduce this plastic problem within our school.






(self-made photo's)

Ideas were grouped by the students, and everyone was allowed to vote (with green sticky notes) for several themes. This helped the class to choose the most important and interesting topics. With a few of our favorite brainstorm idea's we asked all available staff, teachers and students in de school to vote for their favorite solution, or to add an option. Students were also asked to divide topics and to do some literature research on their main topic as homework for the next meeting.

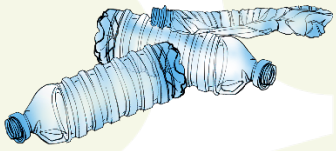
The group contacted the municipality Utrecht and learned about their future plans of post-collection waste separation. This changed the direction of the project from plastic waste separation, to ways of reducing the amount of plastic waste produced in the school. Several ways of waste reduction were proposed by the students. The type of plastic waste mostly found in waste bins, was the non-recycled plastic water bottle. By interviewing teachers, fellow students and school staff members, one favorite idea was selected: a durable water bottle, made from green plastic, that they wanted all students and teachers to use!

The team compared several water bottles on price, looks, possibilities for logo's and sustainability (source material). Students contacted the manufactures of our favorite water bottle.

The team created a distribution plan for the water bottles: a flyer will be handed out to all students and teachers. The flyer will contain information on the project, the plastic problem, and this solution. The plan is to also hand out a few of these water bottles and flyers to other schools in the Netherlands to inspire them to take similar actions.

The team presented this bottle and the implementation plan to the director of the school. He was positively surprised by the idea and promised to make concrete steps after the summer holidays.

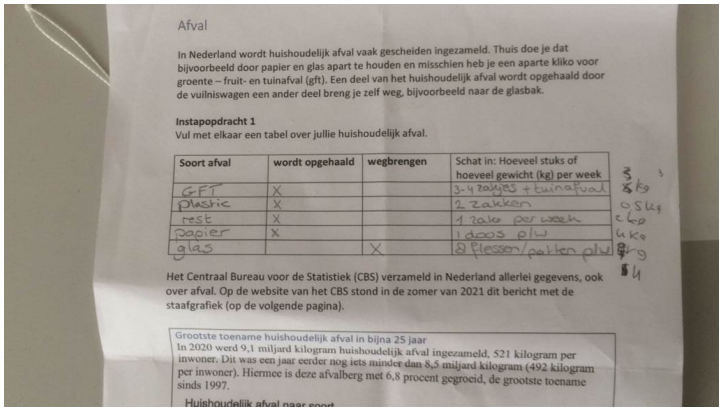
- The success of this SCP was the implementation of activities inspired by appreciative inquiry (discovery, dream, design and deliver - https://appreciativeinquiry.champlain.edu/) and the brains storm and co-creation processes supported by post-its and well organized group work.



(Pixabay pictures)

**Reducing waste in and near school**

This SCP was performed by 15 students in a special ´brain skills´ group that perform extra curricular activities and follow the regular curricula in a reduced time frame. First the students were asked to measure the weekly waste production at home to involve their parents in creating awareness for waste and the need for change. When extrapolating their measurements by calculating yearly production (and comparing these numbers with national averages) the students' interest was raised to focus on how to reduce waste.



Afval

In Nederland wordt huishoudelijk afval vaak gescheiden ingezameld. Thuis doe je dat bijvoorbeeld door papier en glas apart te houden en misschien heb je een aparte kliko voor groente – fruit- en tuinafval (gft). Een deel van het huishoudelijk afval wordt opgehaald door de vuilniswagen een ander deel breng je zelf weg, bijvoorbeeld naar de glasbak.

**Instapopdracht 1**
Vul met elkaar een tabel over jullie huishoudelijk afval.

| Soort afval | wordt opgehaald | wegbrengen | Schat in: Hoeveel stuks of hoeveel gewicht (kg) per week |
|---|---|---|---|
| GFT | X | | 3-4 zakjes + tuinafval |
| plastic | X | | 2 zakken |
| rest | X | | 1 zak per week |
| papier | X | | 1 doos p/w |
| glas | | X | 8 flessen/pakken p/w |

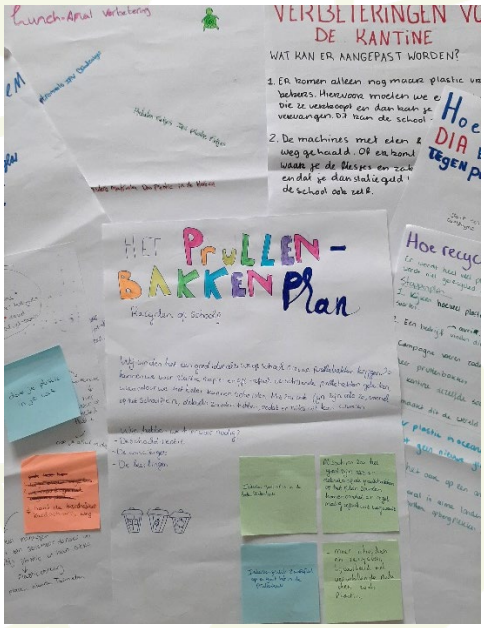
Het Centraal Bureau voor de Statistiek (CBS) verzameld in Nederland allerlei gegevens, ook over afval. Op de website van het CBS stond in de zomer van 2021 dit bericht met de staafgrafiek (op de volgende pagina).

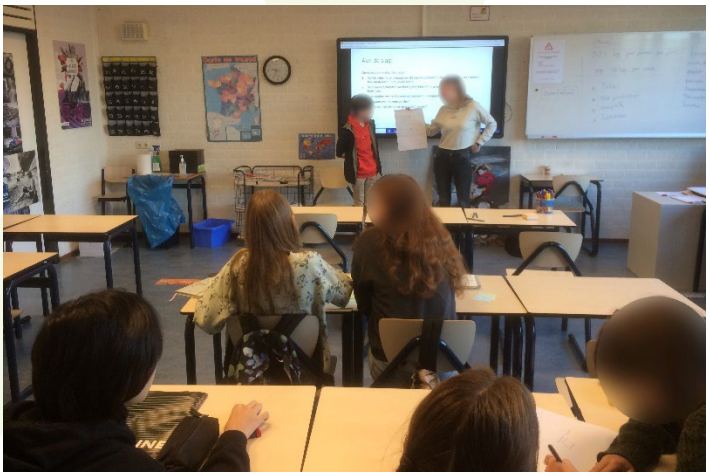
Grootste toename huishoudelijk afval in bijna 25 jaar
In 2020 werd 9,1 miljard kilogram huishoudelijk afval ingezameld, 521 kilogram per inwoner. Dit was een jaar eerder nog iets minder dan 8,5 miljard kilogram (492 kilogram per inwoner). Hiermee is deze afvalberg met 6,8 procent gegroeid, de grootste toename sinds 1997.

Huishoudelijk afval naar soort

After some introductory videos on where (plastic) waste travels and the damage it causes, the students focused on how to reduce waste produced within their school and surrounding the school.

Groups of students did some extra research on their favorite topics. Each group created a poster with the main issue and their solution. These poster presentations were shared with teaching staff and the board of the school. Potential next steps were new and better waste buckets outside the school and less products with plastics in the school canteen.



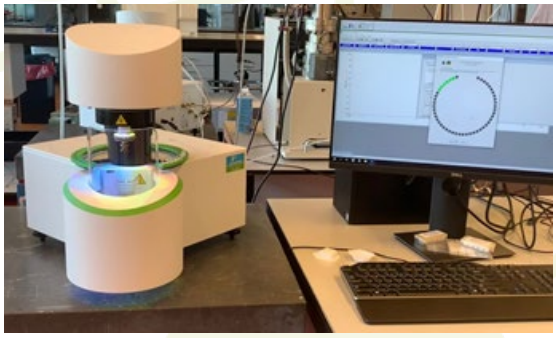
(self-made photo's)

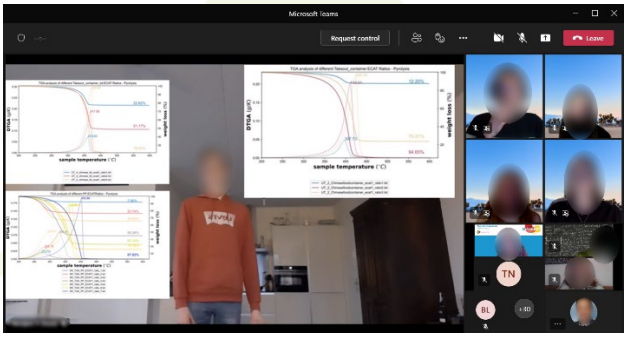
The students came up with creative ideas, in particular the one informed by their experiences on the school playground with waste buckets from which waste easily is blown away by the wind (the "Prullenbakken Plan"). Their solution was seriously considered by the board of the school. Concrete next steps (implementations) were not realized within the timeline of this SCP.

This SCP 2 was successful in the sense that we also piloted the worksheets for a national one day SCP event during which students have to measure waste production with their parents and create research questions for small waste reduction projects that can be addressed in one day. This national SCP event is guided by Utrecht University from a distance, so well-described guidelines for students and teachers were of crucial importance for its implementation. SCP 2 proved the potential of such an approach and helped us to fine tune the guiding materials.

**Recycling plastics**

In addition to these plastic waste projects, a small group of four U-Talent students (age 16-17) carried out their thesis research project that they have to perform at the end of secondary school, with help from a Utrecht University researcher. Their topic focused on the decomposition of plastics in the recycling process. Within several meetings, these students were able to perform experiments determining the differences in decomposition between lab controlled plastics and post-consumer plastics. This research aimed to determine whether the lab controlled plastics used in recycling innovation experiments behave in similar ways as the actual plastic containers we as consumers are using. The students presented their findings at the online U-Talent thesis symposium 2022 and concluded their presentation with “To all future students researching this topic: we helped you, will you continue this work?”.






(Self-made photo’s by students and supervisors)

The new aspect in this SCP was the co-creation process between students and researchers at university. On the one hand it was inspiring for the students to be involved in real research. On the other hand the possibilities to really create a solution for the community was rather limited on the research level.

**Waste @ Mathematics in Teams**

Mathematics is more than performing procedures and also includes higher-order thinking skills like mathematical problem solving, creativity, reasoning, modelling and communicating mathematics. To support schools in assessing these skills in an authentic way, Utrecht University organizes a yearly Mathematics in Teams event in the Netherlands. The Math-Day-15 event in year 2021-2022 was devoted to waste in close collaboration with the MOST project. More than 1000 secondary school students (3havo/vwo, age 15) from at least 13 schools worked for a day in teams of three-four students on a 'large' and open problem. Is waste a problem? Often it is: the plastic 'soup' in the oceans is a major problem. Worldwide, people are looking for solutions for this. In 2021, a deposit was introduced on small plastic drinking bottles in the Netherlands, so that the cans do not end up in the sea. But waste can also be a problem closer to home and school: chewing gum and cigarette butts on the street, litter around schools and supermarkets, leftover food that attracts rats, and so on. Students had to develop a plan to improve the waste situation in and around your school. First, they were encouraged to look at data about waste they produced for one week at home, compare this with yearly numbers for households in the Netherlands, followed by a research in and around their schools.

Figure: Students at one of the schools

As a final product, they had to create evidence-based advises for the school on how to deal with waste (even) better.

Figure: A poster supporting an advice on the location of dust bins

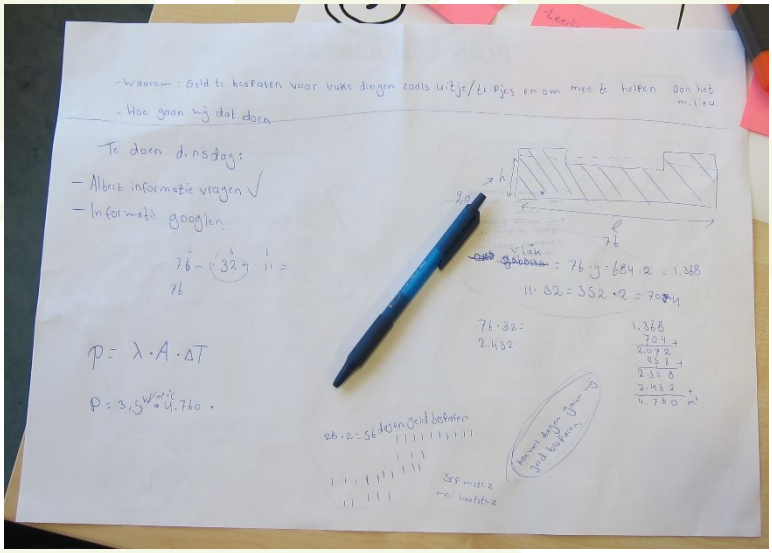
A teacher reflection:
“My students spent an entire day enthusiastically working on the assignment. They reported that it was amazingly fun to spend a day doing math. The homework was about the amount of waste produced in a week by a household. The different numbers prompted discussion and comparison with national figures. It was immediately clear: the huge mountain of waste produced each year is a huge problem. In particular, designing a poster or powerpoint about their research/solution for the school's environment appealed to many students. They also liked that they were allowed to walk around the school and do their own little research. Many groups indicated that they suddenly saw much more waste lying around and would now be more aware of it.”

Students reported:
"We found this day very interesting, as litter is a very hot topic. It made us realize what a big problem it really is. We learned a lot from this day and hopefully something will be done seriously about this problem!"

**Grass up on the roof**

Academie Tien is a secondary school in a new developing area of Utrecht in the Netherlands. The school drives on innovative educational concepts and one of them is time for project weeks. In January 2023 such a week was used to set up SCPs on energy saving measures in the community with a particular focus on a new school building being built. A school leader supported this idea for the intended interaction with neighbors and the importance of sustainability education.


The week started with introductions on energy from a local energy and an IT company, a researcher and a representative of a city lab (RAUM) aiming at creative placemaking. They presented current challenges like the energy transition, charging electric cars and net-constipation and the potential of gardens in urban areas. The 15-16 year old students brain stormed on possible ideas according to a method of appreciative inquiry. They created groups and plans for various topics that involved the stakeholders and community members.



A group of students calculated the gains of lowering the temperature in school with one or more degrees by using measurements and formulas for the area of the school and energy flow through roof, walls and windows. Other groups designed a dashboard and an app for smart charging and plans for (vegetable) roof gardens. The final day they got the opportunity to present their findings at a Fair in school. Local news published an article on this event and highlighted the importance of learning to understand and address the interests of various stakeholders in the community to stand up for sustainability.

The fair was a big success. Parents were impressed by the students' ideas and their presentations with serious plans for sustainability measures. These ideas were not only dreams but their feasibility was underpinned with budgets, timetables and resources needed. What next? The stakeholders, parents, teachers and directors now need to act… Anyway, the students experienced and learned how to bring people together. The school will repeat this activity next year. Their new building will get a green house on a roof to grow vegetables and to "dance up on the roof" for a more sustainable future.

**The waste parade**

A similar national event as SCP1, but this time for primary schools. They will work one full day (March 29, 2023) on mathematics and waste in teams. Circa 200 primary schools will join this event and report their findings.

## Norway

**How can we make Trondheim a "greener" city by reducing household waste?**

Participants:
Students and teachers from Thora Storm upper secondary school, Trondheim

Representatives of the local waste management company (Trondheim Renholdsverk, TRV)

Citizens in the proximity of the school

*Plastic packaging has more lives than a cat! It can be recycled ten times. That is, as long as it does not end up in the general waste before it gets this far. Therefore, it is very important that as much of the plastic as possible is sorted out and given new life.*

Summary:

Trondheim Renholdsverk (TRV) provides waste collection, disposal and recycling services for all private households in Trondheim municipality. In Trondheim there are five main sections of waste; general waste, paper & cardboard, plastic packaging, hazardous waste and glass/metal. The goal of TRV is to ensure that various raw materials are reused as much as possible and in the best possible way. What can be recycled is to be recycled. In addition, they work to minimize the amount of waste, and to reduce emissions. Their waste analyses show that one third of what we throw away in the general waste could have been eaten, reused or pre-separated at the source. Glass and metal packaging can live forever, but in order for them to become new products, we must sort them out at the source. Plastic packaging can be recycled ten times, so it is important that it does not end up in the residual waste. We recycle more plastic than before, but still only 31% of the plastic is returned in Trondheim, so we still have a long way to go.

The students were given access to the analysis of household waste (picking analysis). Based on this, they were challenged to find a solution for how we can increase the recycling rate in Trondheim.

The project was arranged as an innovation camp lasting for 2 days. A representative from TRV visited school and presented their local waste problems connected to general waste, plastic packaging and glass/metal. The kick-off took place in a large auditorium with the headmaster and teachers present. Students worked in groups of four or five with one of the presented challenges. They were free to choose type of waste and were encouraged to find a solution on how to reduce the amount of their selected type of waste. Some groups made interviews with citizens nearby. TRV was available for questions during their work. At the end of day two, each student group presented their solution in the school's amphitheater, either as a video, poster or digital presentation, and two representatives from TRV served as a panel of judges.

Student solutions consisted of a deposit scheme for plastic, glass and metal, to avoid or reduce recyclable packaging in general waste. They also suggested information campaigns, better labeling of packaging, and better information on where to find return points, e.g., integration in online maps.

As stated by one of the teachers: “I think the students came up with good solutions, even new ideas and things that we had not thought about ourselves either. What I am most pleased with is the representative from TRV who posed very good questions, and the fact that there was a utility value in the project is very, very good. That it can actually be used for something”.

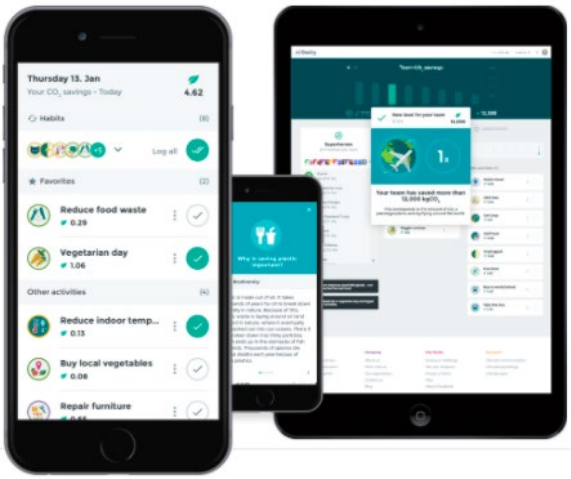
When talking about student solutions and products, the TRV representative expressed her gratitude: “They have provided us with a product. A beautiful production, which in itself has a value for us! It can actually be used for something”.

Students felt they became more conscious after the project, e.g. “At least, I sort my plastic waste better now”, and appreciated the way of working: “It's a bit exciting because it's a bit different from the usual school life, right”.

Source: Pixabay, https://pixabay.com/no/photos/s%c3%b8ppelkasse-s%c3%b8ppel-milj%c3%b8forurensning-1260832/

**The Waste Reduction Race: A Path to empowerment!**

**The Waste Reduction Race** is an initiative created by the students in **Trondheim International School (THIS)** as part of the MOST project**.** This game-like campaign aimed to see how to minimize waste and reduce unnecessary consumption in a playful and meaningful way. The students from the Middle Years Programme (MYP 9) set a goal to gain a better knowledge on waste and observe how individuals can make a difference when collaborating together.



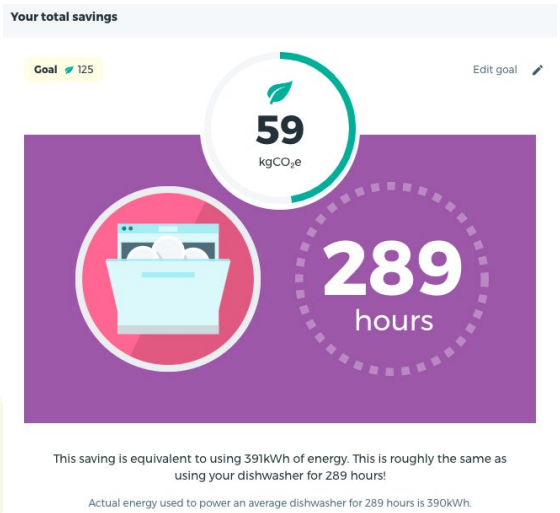


As the school community projects (SCPs) in MOST aims to strengthen collaborations between students, teachers, community members and other stakeholders, the students recruited teachers, parents and SINTEF Ocean as a research organisation to take part and compete with them in this climate challenge. The recruitment of SINTEF was done through one of the parents at THIS.

Nothing can be more fun than competing in a game with your classmates and teachers, even more when adding another level to compete with parents working at SINTEF Ocean along with

researchers working on innovation and sustainable use of the ocean.

The challenge lasted for two weeks, in which 57 participants from three teams (Students, Teachers, and SINTEF Ocean) competed together using a Ducky platform through logging concrete climate activities based on Norwegian consumption data using nudging, positive climate actions, and peer-influence.




The Climate activities included daily climate activities as switching-off unnecessary lights, reducing indoor heating, eating vegetarian, and recycling waste. In the Ducky platform, the participants could track their progress with the other teams, setting goals, and give real time climate data, with comprehensible climate translations making the competition even more meaningful and joyful.

During the two weeks challenge, the participants managed to log in around 4400 climate activities and saved around 4000 Kg $CO_2$e which is as much as 410 trees absorb in a year. Looking at the bigger picture, if everyone in Norway did this, that would amount to a 19% reduction in Norway's total greenhouse gas emissions! What a spectacular achievement!

In the competition, researchers from SINTEF felt more engaged in environmental issues, learned something new, and felt that the challenge was a good way to reduce emissions.

If you are wondering who the winner of the Reduction Waste Challenge is, it is everyone!

Glimpse from participants at the Reductions waste Race:

*The climate challenge "raised awareness of how specific actions can reduce waste".* **Teacher, THIS**

*"I felt like I was part of the solution and had the opportunity to make a difference".* **Students, THIS**

*"It's mostly not about the competition, but useful to see how much we can reduce emissions by taking different everyday choices."* **Researcher, SINTEF**

*"It is so inspiring and powerful to see the engagement among the different stakeholders in this project. Especially when it is connected to important SDG's as Climate Action and Responsible Consumption & Production''* **Project leader, Ducky**

## Insights from the Reduction Waste Challenge:

### Most popular activities - Trondheim International School

Activities logged the most number of times

**I switched off unnecessary lights today**
452
number of times logged

**I reused my clothes today**
302
number of times logged

**I wasted no food today**
332
number of times logged

**I recycled as much waste as possible today**
299
number of times logged

**I reduced the indoor temperature over night**
324
number of times logged

**I reduced the indoor heating today**
289
number of times logged

### Total Savings - Trondheim International School

Some comparisons to give you a better understanding of what you have achieved

Total kg$CO_2$e saving
**4,097**

This is roughly as much $CO_2$e as 410 trees absorb in a year.

One adult tree absorbs roughly 10 kg$CO_2$e a year

Average participant saving
**80**

If everyone in Norway did this, that would amount to a 19% reduction in Norway's total greenhouse gas emissions *.

* Norway's greenhouse gas emissions are 54 million tonnes $CO_2$e per 2015. Source: Statistics Norway

**UN Sustainable Development Goal labels - Trondheim International School**

A brief summary of which activities were logged under the UN Sustainable Development Goals categories


**1,122 activities were logged with this SDG tag**

138% of participants logged activities with this SDG tag


**1,100 activities were logged with this SDG tag**

138% of participants logged activities with this SDG tag


**1,024 activities were logged with this SDG tag**

138% of participants logged activities with this SDG tag


**693 activities were logged with this SDG tag**

136% of participants logged activities with this SDG tag


**345 activities were logged with this SDG tag**

105% of participants logged activities with this SDG tag


**144 activities were logged with this SDG tag**

100% of participants logged activities with this SDG tag

## Chewing Gum


**MOST Project: Chewing Gum**

Year 5 students at Birralee International School in Trondheim have developed a project with the aim of reducing the amount of discarded chewing gum on our streets, both here in Trondheim and (hopefully) throughout the rest of the world.

The project began by passing the power to the students; we challenged them to find a waste related problem in the city and then to develop a project based on this. The class decided that we would need to go out into the community to explore these problems for ourselves.

As a class, we visited a number of local areas to look for problems. We found issues surrounding litter, food waste, recycling, cigarette butts and chewing gum. It was some mathematics that led us to focus on chewing gum, as we found out that there were 16 pieces of chewing gum per square metre in popular areas of Trondheim centre.

Once we had decided on our mission, we investigated the impact of chewing gum on the streets and looked closely at the problems this can cause. The children created multimedia presentations to highlight these issues and even wrote Haiku poems to warn people of the dangers.

Having identified the problems, the next step was finding solutions. The children used the internet to research the impact of chewing gum in other countries and what the best solutions were. We found that in England, there was an initiative for 'gum only' bins that had reduced gum on the streets, saved the local councils money and the chewing gum collected had even been recycled to make other items, including the gum bins. We decided to plan and build our own gum-only bins.


Once we had created our bins, we made television adverts to promote these to the local Kommune and also to share with the community to raise awareness of the problem.

We also wanted to send our message to chewing gum companies and chewing gum consumers so developed alternative chewing gum packaging that carried warnings and information.


We now had a range of ideas and products but we needed to find a way to share our message and find people that could make our ideas a reality. We contacted Trondheim Kommune and arranged a digital meeting. The children shared their findings and pitched their idea for gum-only bins in Trondheim.

The Kommune were impressed and agreed to consider our proposals.

The next step was to promote our ideas to the wider community. We held an open day for children at the school and parents where we shared our message far and wide through presentations, games and models.

We did not stop here. We wanted our message to spread further than Trondheim, so we contacted Supernyyt, a national news broadcaster for children. They decided to take on our story and our project was shown live on national television. You can watch it here: NRK Super - Supernytt


The impact of our project is still ongoing. We believe that we have altered the mindsets of thousands of people and our gum bin proposals may yet one day become a reality. The children were thrilled with the impact that their project had and were delighted to be involved in something so powerful and meaningful.


**Solar panels on rooftop of school building – a solution to the energy and climate challenges in Norway?**

For one week, autumn 2022, the science class from grade 12 at Thora Storm upper secondary school in Trondheim conducted six different SCPs. Their overall research question was: How can solar power be a solution to energy and climate challenges in Norway? One of the student groups explored how much solar energy their school could produce in one year, by installing solar panels on the roof of their school building. Their research question was: Is it wise for Thora Storm to start with solar power?

The students were given a practical introduction to solar cells in a solar cell laboratory at the university. They gained theoretical knowledge with lectures from researchers from Department of Electric Energy, Norwegian university of science and technology (NTNU) and consultants from Norconsult AS.

The Department of Electric Energy works in close collaboration with industry partners to develop technology for the production of electric energy from renewable energy sources, and to contribute to research that leads to solutions for the future power grid, with high relevance for the society, addressing industrial needs and global challenges.

Norconsult is one of the Nordic region's largest interdisciplinary advisory groups. The company has broad and interdisciplinary expertise in all areas that affect solar energy and offers services in all phases of independent solar energy projects and other projects where solar energy is included. Their aim is to contribute to solar energy projects being solved in the best possible way according to energy yield, quality, economy and environment.

The students from Thora Storm worked intensively with their own research questions for two days. They were encouraged to involve local community members of relevance for their questions. Their results were presented at a mini conference at the school where the students presented orally and via posters. External actors from Department of Electric Energy, NTNU and Norconsult AS were

present, evaluated, voted for and awarded the best contribution among the six different SCPs. The actors were impressed by the quality of students' work.

The group working with solar panels on rooftop found the following solution: Thora Storm can cover around half of its own power needs with solar panels on most of the roof surface. The plant probably has a payback period of 15-30 years. As written on the poster, the students concluded: "According to our calculations of the repayment of the solar cells, the school will turn a profit after 15-30 years and continue to earn from its own electricity production. The school will then save a lot of money on the electricity bill and can then have the opportunity to expand the offer of other things. In addition to the financial benefit, there will also be a value of learning for the students at the school. With these two factors taken into account, it will certainly be a good investment for Thora Storm to install solar cells on the roof".

Taken all the SCPs at Thora Storm into account, the class as such recommend using solar power on a much larger scale than today, as a supplement to our other renewable energy sources.

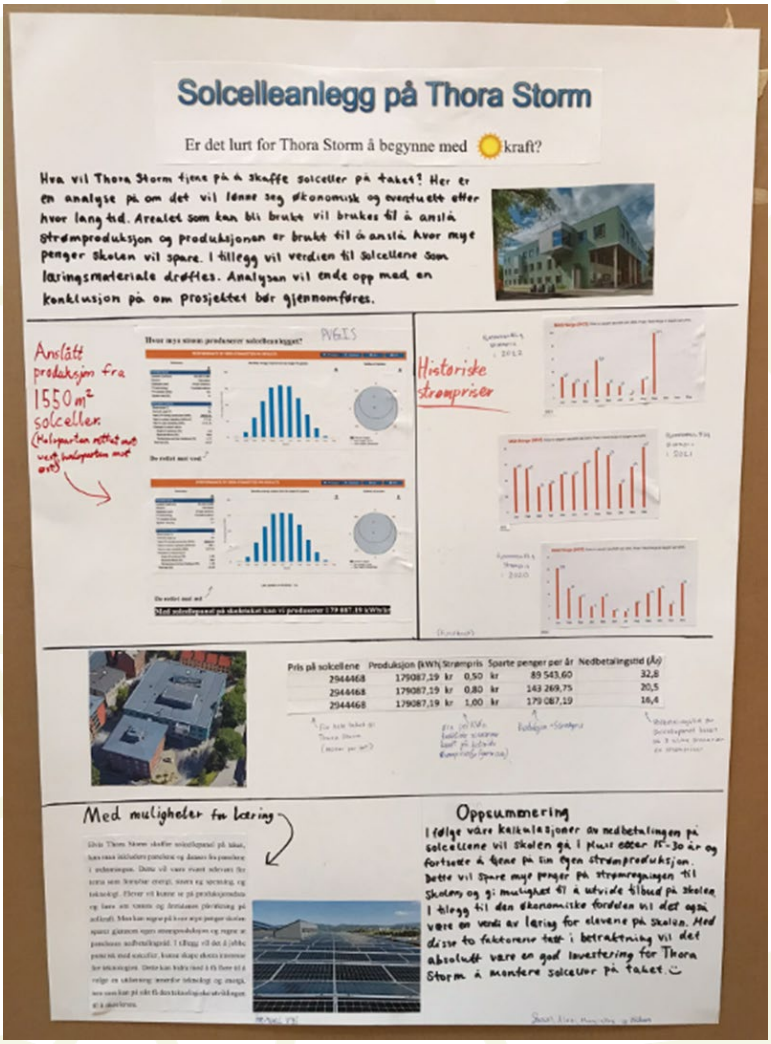
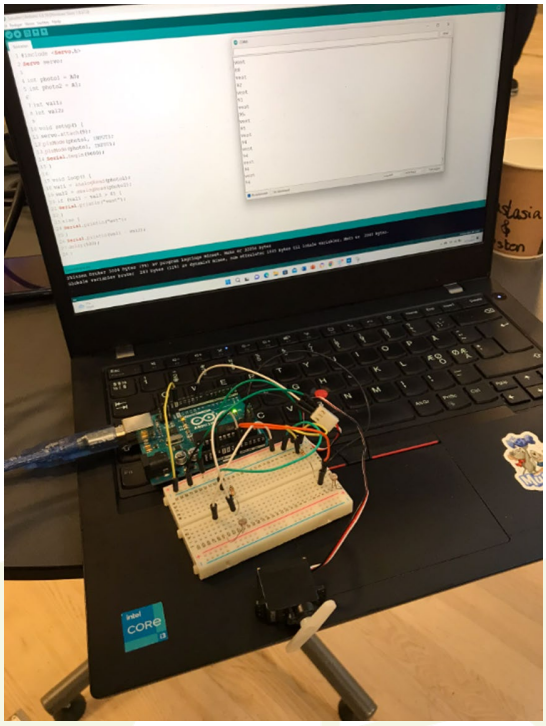
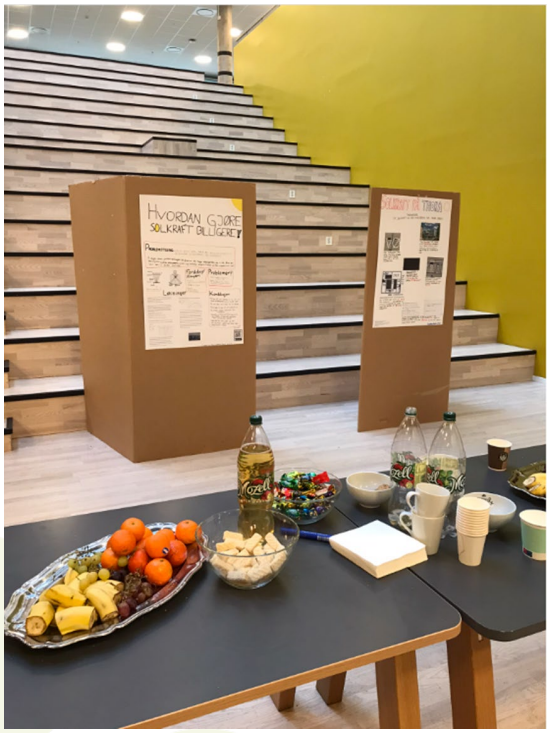



Photo: Ragnhild Lyngved Staberg






Photos: Ragnhild Lyngved Staberg/NTNU

**Energy Reduction Challenge**

Year 9 students (MYP9) and their teachers from Trondheim International School wanted to find a way to motivate the local community to save electricity. The project involved both students and students' families. 21 students (12 female) and 3 (1 female) teachers did participate in the project. With 39 external participants from the community, a total of 60 people were involved in this SCP.

They organized their project in four phases:

1. Enquiry: Learn about energy

In the first phase of the project, a professor from the University of Trondheim was invited to give a lecture on different forms of sustainable energy. The students were split up in groups. Each group enquired more about one type of sustainable energy and organized knowledge and facts that had been obtained. They prepared presentations and shared their knowledge with other students and teachers at the school by presenting the results in the form of posters on a dinner arranged for the school community.

2. Action: Energy competition

They decided to conduct an energy *competition* where the students' own families and others were challenged to save energy and contacted the company Ducky for cooperation. Ducky is a young company run by young people with knowledge and commitment, and the company offers an app-based solution that let organizations quickly and easily set up challenges and help individuals, organizations and schools to monitor, learn about and improve their carbon footprint.

Each student was to ensemble their own team of 5 external members from family, friends, neighbors, etc. 258 were invited to join the competition. 60 chose to participate, forming 43 teams. This gives a participation rate of 23 %.

The competition the *Energy Reduction Challenge* lasted 14 days. The teams were to compete to save as much energy as possible. The students could monitor the progress of the competition during the whole period. After one week the students launched a planned and prepared campaign to raise attention to the importance of saving energy, with tips on how to do it.

3. Reflection

The students used the results generated by the Ducky app as a starting point for their own analysis and reflection on the results. The analysis of data shows that the competition resulted in total savings of 2,700 kg CO2e (carbon dioxide equivalent), which is roughly as much as 270 trees absorb in one year. The various activities of the participants were logged and categorized under the UN Sustainable Development Goal labels.
The students identified winners of the competition, and the results of the competition were sent out to everyone who had participated.

4. Going Further

As a continuation, the students themselves chose two/three forms of energy for in-depth investigation. They formulated their research questions and planned their work further.
In their work, they evaluated their sources for information and documented their own research process. Perspectives and implications of their chosen types of sustainable energy were explored and presented by writing essays.

This is a success story because the students managed to point out the great potential for energy saving that follows when each person takes some simple measures in their everyday life, and that the sum of many small contributions becomes a large savings. Through a good collaboration with an external partner, Ducky, they gained access to both knowledge and tools. They acquired external expertise early in order to build their own knowledge and they managed to engage the local community to participate. They then passed on knowledge back to the participants, so that their SCP can have an effect beyond the two weeks of the competition.

Through the work in the final phase, they have built further knowledge about energy and energy sources and about the implementation of research projects.

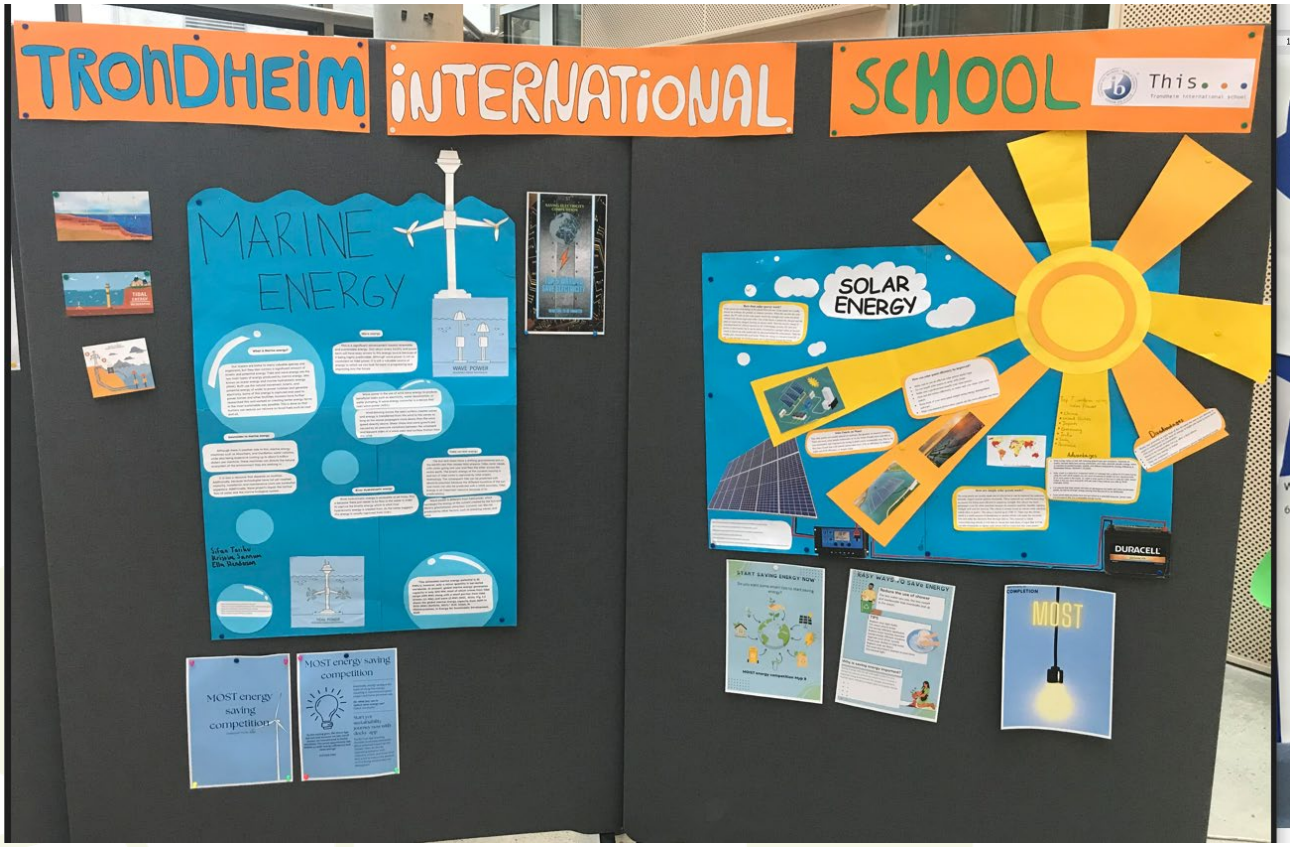
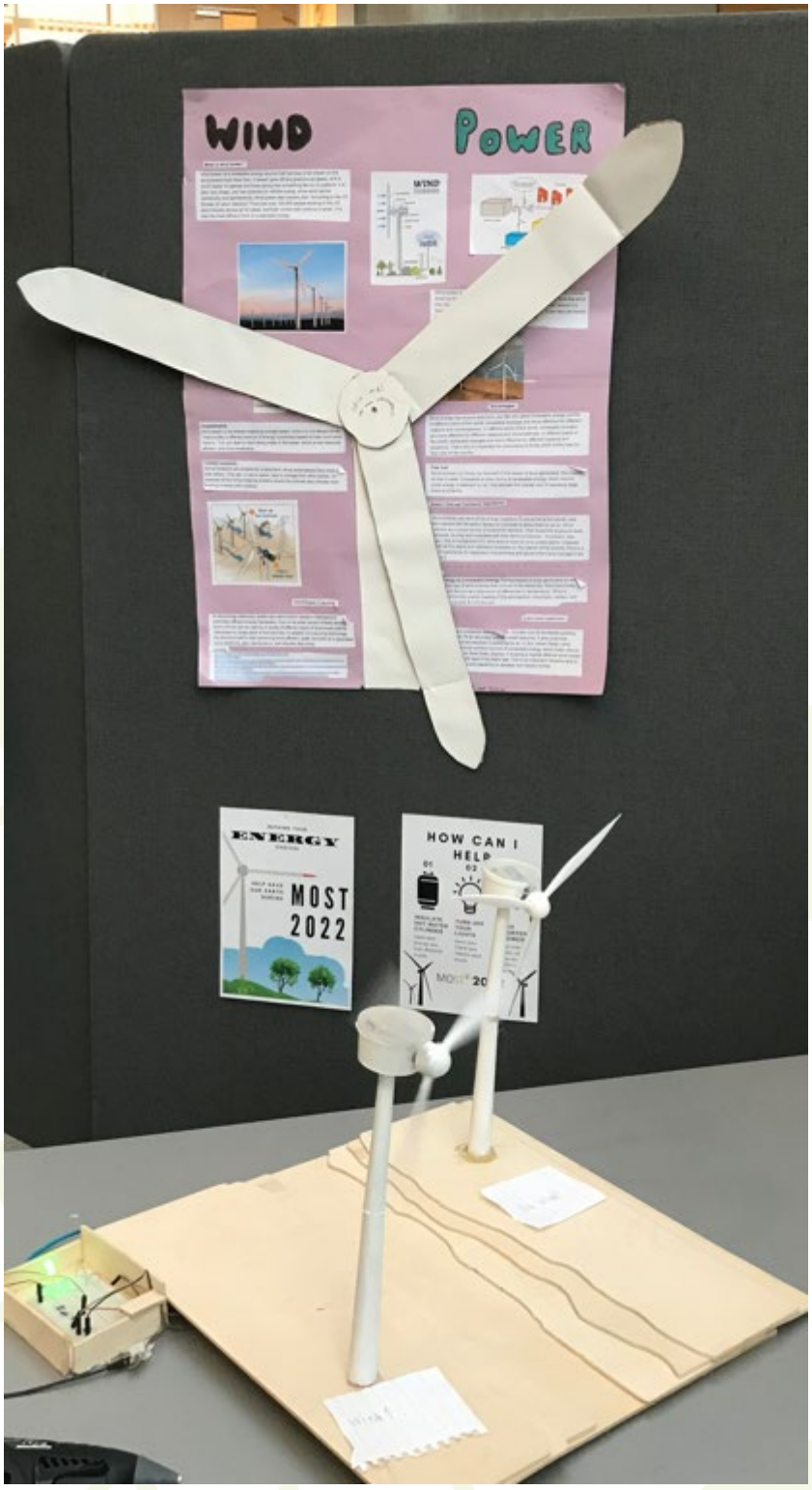



Photo: Ragnhild Lyngved Staberg/NTNU




"Wind Power". Photo: Ragnhild Lyngved Staberg/NTNU

**ENERGY AND WELL-BEING: How Can We Reduce the Impact of Blue Light on People's Health and Well-being?**

In autumn 2022 – spring 2023 the 25 children – 15 boys, 10 girls - in Year 4 (age 9) at Birralee International School, Trondheim, Norway worked for approximately six weeks with the SCP project. Given the overarching theme of Energy, the school had to find ways how to translate the theme to make it accessible and applicable to young children, since energy is quite an abstract concept for them. Furthermore, given the project framework of being community-based, it was not obvious at the beginning what authentic problems in the community that were relevant to be solved, neither was how the involvement with the community could be made.

The school has then developed a model of SCP implementation, in which SCP was anchored in the International Primary Curriculum (IPC) (see explanation about IPC in the link given further down). The Year 4 teachers identified a teaching unit called "Full Power!" in the IPC, and with the support from the school leader and science teachers from the middle school, they worked out the teaching module so that it focused on "Well-being and the consequences of covid". The module was inspired by the fact that children and adults were, to a much higher extent than usual, exposed to digital screens during the covid lock-down period. Year 4 children started to ask themselves how too much screen time will affect our health? This question developed into more elaborated ones as they focused their SCP on the topic of BLUE LIGHT. The children investigated different aspects of blue lights, such as "What is a blue light?", "How much are people exposed to blue light?" "What risks can blue light have on people's health and well-being?" and "How can we prevent health hazards caused by blue light?". A student explained: *"Blue light is a light that comes out of the screen".* Here they saw the connection between blue light, energy and the potential health hazard it might cause.

The school collaborated with the community by encouraging students to conduct surveys to families, friends, all teachers at the school, etc. about their daily habit on use of electronic devices, for instance asking on the average daily screen time. *"And Year 4 again, they're hoping to do more involvement through surveys and asking people. So, they sent out surveys about blue light for example and that's how they've involved people"* (School leader interview). Based on the survey data, the students made statistical analyses, they found among others that 43% of adult work requires using tablets or computers, and nearly 70% of the informants experience a sort of eye strain. The students also made research on potential problems blue light can cause, especially for children, and found that blue light can *"mess up sleeping patterns, affect the eyes, to some extent damage brain, and affect the mental health"* (Student presentation). They concluded that measures had to be taken to help people prevent further health hazards caused by blue light.

The class was divided into groups who worked in finding solutions to the different problems. Some groups worked on solutions to blue light hurting their eyes; they investigated facts about blue light and created informative posters while another made fake models of blue light filters like glasses and visors. The filters had the size of a mobile phone, a laptop screen, a desktop screen and glasses, so they had to make measurements of those devices. They also wrote letters to the school leadership

to ask for blue light filters for the school devices. The students recommended that the school invests in blue light filters.

Other groups worked on making electric circuits, created campaign videos, made games/ quizzes (Kahoot), did inquiries on electric energy, such as the advantages and disadvantages of different types of power plants (hydro, nuclear, solar, etc.) and made models from recycled materials.

The SCP allowed them also to work cross disciplinary, combining science (e.g. learning about blue light, power plants, electric circuits) with English language (e.g. by writing letters and making presentations), Design & Technology (by making models), and Mathematics (cf. measurements & calculation to make models and statistical analysis). In addition, the children developed their soft skills, such as communication, teamwork, empathy, time management, problem solving in addition to being resilient and ethical.

The potential outcome of the SCPs was to spread awareness to people of the danger that blue light can do, especially to young children, and encouragement to the school administration to invest in blue light filters for use on school devices.

*Dissemination*

The students shared their work with other SCP groups from outside school at the MOST Fair at NTNU. In addition, the school organized an Exit Point, where the students made exhibitions of their work and disseminated their results to parents, and to other students in school.

*Why is this SCP exemplary?*

This SCP is considered exemplary because it addressed real, authentic problems faced in the society, where people of all ages (from young children to adults) seem to increase their screen time in front of electronic devices in their daily life. This SCP is also exemplary because it provides a new, original angle to address problems about Energy – that is by connecting it to the health issue. In addition, by working with the SCP, the young children gain knowledge and learn soft skills that are important for their future. Since they are now aware of the effect of blue light on health, it will, hopefully, help them to be self-regulated and make wise decisions regarding their screen time.

In terms of professional development, the school leader thinks that this project has allowed the teachers to gain tremendous knowledge: *"I think for the teachers this project made them think a lot harder. They had to think of the ways to make it accessible, think of the ways they can make into community-based, and then check on the subject as well"* (school leader interview)

The parents too seemed to be enthusiastic that their children were involved in the SCP. Here are some comments from a parent:

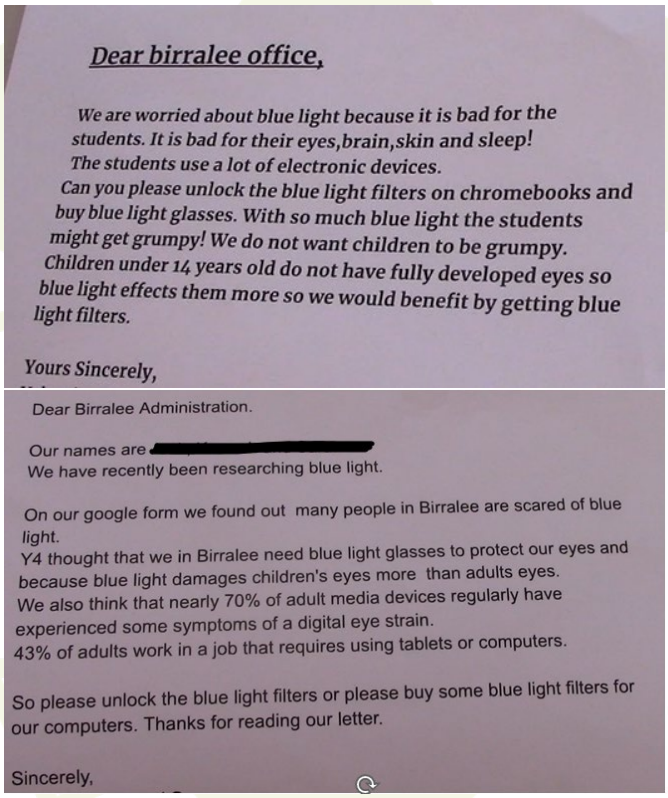
*"We enjoyed the MOST project and interactions that it provided around the blue light and covered topics both at home and in the school, as well as the opportunities for students to develop their research skills"* (Parent survey)

*"The main impact was to facilitate research on the given topic at home and in school, encourage shaping questions and forming them in the questionnaire, learn more about analyzing data, gain further skills in presenting and overall increased awareness"* (Parent survey)

Links:

IPC: https://www.goodschoolsguide.co.uk/international/curricula-and-exams/the-international-primary-curriculum

**PHOTOS**



*Dear birralee office,*

*We are worried about blue light because it is bad for the students. It is bad for their eyes,brain,skin and sleep! The students use a lot of electronic devices. Can you please unlock the blue light filters on chromebooks and buy blue light glasses. With so much blue light the students might get grumpy! We do not want children to be grumpy. Children under 14 years old do not have fully developed eyes so blue light effects them more so we would benefit by getting blue light filters.*

*Yours Sincerely,*

Dear Birralee Administration.

Our names are [redacted]
We have recently been researching blue light.

On our google form we found out many people in Birralee are scared of blue light.
Y4 thought that we in Birralee need blue light glasses to protect our eyes and because blue light damages children's eyes more than adults eyes.
We also think that nearly 70% of adult media devices regularly have experienced some symptoms of a digital eye strain.
43% of adults work in a job that requires using tablets or computers.

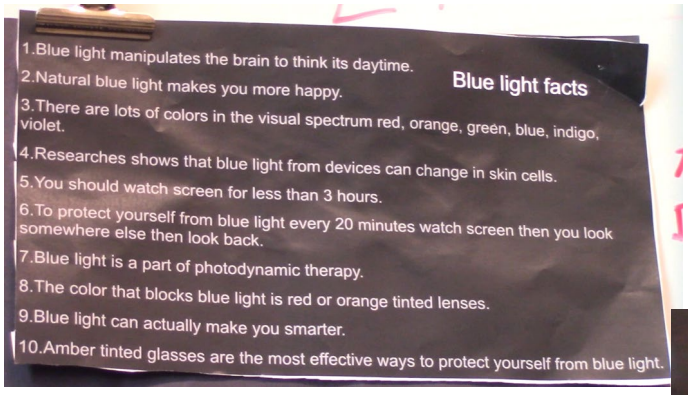
So please unlock the blue light filters or please buy some blue light filters for our computers. Thanks for reading our letter.

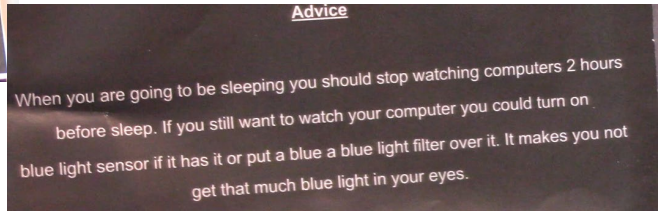
Sincerely,

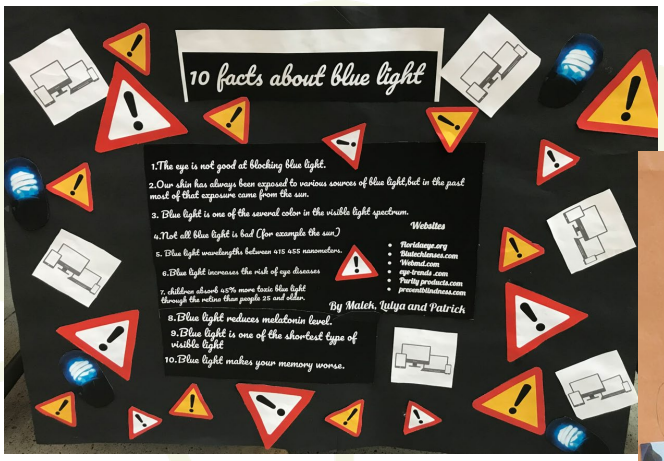
*"Examples of letters". Photos: Maria Febri*

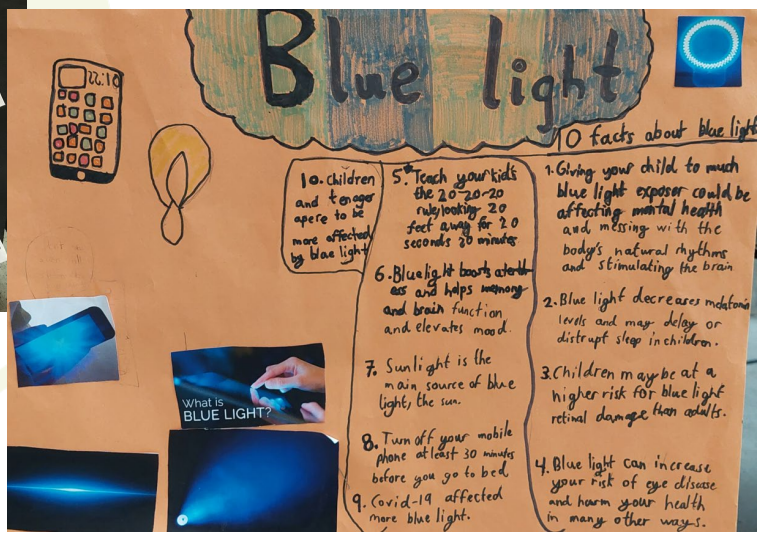

*"Statistics about blue light" Photo: Ragnhild Lyngved Staberg/NTNU*


*Photo: Maria Febri/NTNU*

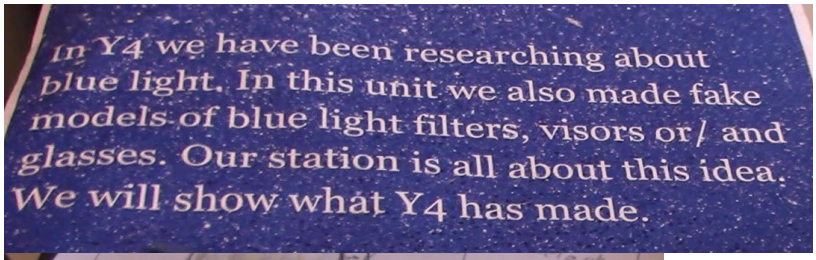


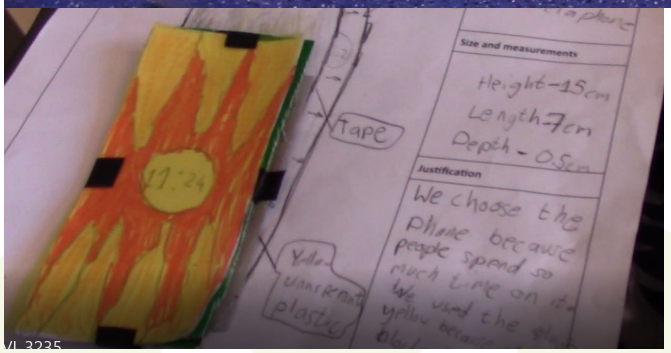




*"Examples of poster – 10 facts about blue light and advice". Photo: Maria Febri*




*«Examples of filters». Photo: Maria Febri*

## Spain

MEZCLADOS – CEIP Alfredo Cazabán (Jaén)

### Colorful and collaborative learning: the way to inclusion

This SCP involved 21 primary school students (second grade), 1 teacher and 13 members of the community. It was born during the last days of the previous academic course 2020/2021, when students realized that they did not know where they had to through away the used staff from their pencil cases: In which bin did they have to throw the waste they found? Many questions arose: "Teacher, where can I throw the old markers? And the dry glues? And the wax crayons? Facing this problem, the students investigated and discovered that the waste of school materials should be deposited in the clean point and they decided to collect all the waste of the whole schools, to classify it and to carry out a school cooperative in which to manufacture objects from the waste with the help of the residents of a Residence for the Elderly and the Art School of Lugo (Galicia). Then, they would sell those objects to donate the profits to the Food Bank of Jaén and finally recycle, where appropriate, what cannot be reused.

Thus, wondering about the waste from their pencil cases, students became deeply interested in the Colour Theory and how to make something beautiful with artistic value from school waste. To learn about how to do so, they started a collaboration with the School of Art "Ramón Falcó" in Lugo, which became an active member in the SCP, supporting and inspiring students to make their own creations. In addition, students got in touched with the Residence for the Elderly "Altos de Jontoya" in Jaén, initiating enriching interactions between the kids and the people of the residence, who got also involved in the project, sharing fundamental values related to caring, respect, inclusion and mutual support.

This project represents a successful story because it is a nice example of approaching a real problem that arises from the curiosity and concern of the students. It involved different community members, who got fully committed to the project, valuing the role of the school as a transforming agent of society. During the development of this project, the students applied mathematics meaningfully, while using calculations and making estimations for their cooperative and learnt science while trying to understand light and colour as a result of the interaction between energy and matter and when they inquired about the environmental impact of inappropriate waste handling. In addition, they discussed fundamental values related to tolerance, open-mindedness and acceptance of diversity through the study of the different colours that the human skin can have, recognising common biological features and the beauty and value of diversity.

El club L@S PEATONIN@S –Names of the public schools involved: Nuestra Señora del Rosario (Villacarrillo) and Francisco Vílchez (Arroyo del Ojanco)

**Small people but great citizens**

The Early Childhood students (4 years old) of the school Nuestra Señora del Rosario from Villacarrillo and the 3-years-old students of the school Francisco Vílchez from Arroyo del Ojanco, participated in the project together. The initial motivating activity was a video of the local police showing their concern about the high levels of pollution in both towns. They asked students to become part of the pedestrian patrol collaborating to raise awareness among people of the neighbourhood about the importance of moving on foot or using sustainable transport and thus reducing the use of the car.

To do this, girls and boys identified challenges and made suggestions to overcome them. They learnt the importance to behave correctly as pedestrians, they detected possible architectural barriers, potential risks and places where mobility was somehow limited or constrained. They developed model to study the streets and how to make mobility more secure and sustainable. They got involved in the design and development of key elements such as security vests, signs of traffic, informative murals and carried out an awareness campaign against climate change. In addition, they created different routes and established the “andabús” with the help of families and the City Hall. This “andabús” consisted of groups of children who live in the same neighbourhood that meet at a particular point to walk to school, accompanied by one or more adults, who committed to being part of this initiative. In addition, a Decalogue of environmental guidelines was prepared and distributed among the inhabitants of the towns. Throughout the whole process, students learned what climate change is and became aware of the importance of carrying out small daily gestures to fight it.

This project represents a success story with a significant impact outside school. The cars that families used to take students to school in the morning and pick them up at the end of the day was significantly reduced thanks to the establishment of the “andabús”, contributing to sustainable mobility, cooperation between families and the reduction of air pollution. Therefore, this is an evidence that just a great idea, with no extra-cost or invested material, and the implication of the families can be the solution to real environmental issues affecting the town.

In addition, this project makes sense as a whole, since it is part of a problem presented from outside the school (it was the local police that warned of the high levels of pollution in the city) that requires the active participation of students. During the development of the project the students were trained about how to behave as good pedestrian and got a special card as a recognition of their good behaviour and valuable contribution. During the process, they had to inquiry about how people came to school, the potential architectural barriers and the environmental and economic impact of travelling by car, applying mathematics and science in a meaningful way and developing sustainability consciousness and scientific literacy.

Building an ecologic park - CEIP Gloria Fuertes (Jaén)

**From school to action**

This SCP emerged from the analysis of some of the problems of the neighbourhood surrounding the school: dirty streets, open areas next to the school usually full of waste, lack of green areas near the school, poor recycling habits and scarce recycling containers or bins in the neighbourhood.

With this in mind, the objective of this SCP was to design an ecological park for the Boulevard neighborhood, where the school was located. This park would improve life not only the neighborhood but also the city as a whole and our planet. The investment was minimal since the park would be built with recycled materials and be self-sufficient through trees with solar panels and rain collectors. Being a living project, the final product will be a model of the park that will grow little by little. This SCP has been taking place from October 2021 to June 2022, therefore it is currently under development, and involves the entire school although the actions to carry it out are different at each educational level.

To design the project, different initiatives were organized collaboratively. First of all, teachers were informed about the SCP and the next step was to involve community members to make the project come true. The different participating courses were surveyed for the possibility of having a father/mother expert in architecture. A student's father is an architect and he joined the project to help in the design of a construction plan based on the ideas that came to him as a result of the different proposals made by students and teachers. Then, each course/class began to work on their intermediate tasks and the search for solutions to build an ecological park.

In the case of the third cycle of primary school (5$^{th}$ and 6$^{th}$ grades), they were in charge of actions concerning recycling and making videos for the advertising campaign. For instance, in the subject of Natural Sciences, they investigated solid waste and its recycling process, all the research reports were collected in Google Sites. In the case of the Language lessons, they work on persuasive texts with the aim of writing a letter to convince the Mayor of Jaén of the convenience of building the ecological park for the neighborhood and for the planet. A radio program is also being developed and some advertising videos are expected to be produced. In Mathematics, a questionnaire was developed to survey the members of the educational community about their recycling habits and results were analyzed statistically. Students also took measurements on a mockup of the park to transfer them proportionally to reality, as well as actual measurements of different areas of the plot on which the park is to be built (perimeters, surfaces...). In Robotics and Computational Thinking, different proposals for designing several park elements were discussed, such as: trees with solar panels, fun containers, an amphitheater, etc. Finally, in Plastic Education, they designed different park spaces with recycled materials.

In conclusion, this SCP has contributed to raise awareness in the community about the need to improve spaces in the neighborhood where the school is located, to design proposals for the building of an ecological park rehabilitating a deteriorated location near the school, and to

encourage interaction between families in the neighborhood allowing them to enjoy a new park in the future which highlights their social impact on the community.

## YOHAGOMIPARTE - CEIP PADRE REJAS (JAMILENA, JAÉN)

**The change begins in oneself and there's strength in numbers**

This SCP focused on the renewal of habits and care of the closest environment from the school and town context. It involved the early-years and primary levels of a public school located in Jamilena, a small town near the Jaén, and took place from October 2021 to June 2022. Although many rural traditions and customs are maintained in this town, there is an excessive consumption of processed products, a misuse of means of transport and a neglected aspect of the environment. To address this issue from the classrooms, students and teachers made the educational community and the inhabitants of Jamilena participate in the importance of not only personal care, but also environmental care; promoting collaboration with the family association, the City Hall and a Secondary School. Therefore, the main challenge of this SCP was the improvement of some deeply rooted habits in the context of the school and the town which do not favor a healthy lifestyle as unbalanced eating habits or a polluted environment.

To address this issue, the teachers involved in the SCP set up an entry event to raise the awareness of students about the problem. For that purpose, they scattered garbage around the playground and passively awaited the reaction and action of the students. Then, the teaching team proposed a series of tasks in relation to the exposed situation, although students themselves decided about the actions to be taken to solve the exposed problem in each class and educational level. Some of this task involved creating an awareness campaign using statistics regarding healthy habits in our environment, collecting waste from the school, making protest in the town to raise awareness about waste reduction, posting photographs of the waste found in the town at different locations, promoting the use of bicycles for trips to school, growing a vegetable garden, etc. To make these ideas more far-reaching, students met with the city council to request their collaboration. In addition, other activities were carried out to encourage the SCP to go beyond the walls of the school as building an accompaniment patrol to come to school on foot, a healthy cooking Youtube channel involving the participation of families, a virtual solidarity race in collaboration with associations related to child illness, recycling and good habits tutorials in which the students recycling patrols trained and raise awareness on waste management of the Jamilena citizens.

The SCP was disseminated through the school website as well as on its social media. In fact, a logo and a specific hashtag (#YOHAGOMIPARTE) was used to promote the project. In addition, the SCP was presented in the 2nd MOST Fair at the University of Jaén showing posters, videos and a talk by participating students about the project. Moreover, teachers and students involved in the project created different merchandising items such as fabric bracelets or key chains designed and produced using a 3D printer in collaboration with a close Secondary Education school. Finally, the different

festivities celebrated in the school throughout the months were linked to the project and, to facilitate its dissemination, choreographies and songs (working as jingles) were represented to bring it closer to the inhabitants of the town.

Some of the strengths that turned this SCP a success story included: the beginning from a real context, the used of co-creation dynamics between students and teachers to look for solutions, the key role of students as the main drivers of the SCPs, the dedication of specific spaces and time during school hours and within curriculum to the project, the collaboration between teachers, the promotion of inter-generational learning, the real impact in the town, the expected long life of the project.

Through this project the school was empowered as a relevant agent for the awareness of Jamilena about the importance of healthy lifestyle habits for the environment. In fact, this project has had a deep impact on Jamilena citizens so that the elderly people talked regularly about MOST and the participating students took ownership of the project and understood the need to include more people in the fight for their cause.

50/50 goes out to recycle – MARCELO SPINOLA SCHOOL (JAÉN)

**The distance to the container cannot be the excuse**

This SCP was carried out at the Marcelo Spinola School in Jaén. It is a Catholic and concerted Center supported with public funds. There are about 325 students from three to 15 years old, from Early Childhood, Primary and Secondary Education. The geographical situation of the Center (Jaen South surrounded by other educational centers) makes them seek excellence and specialization in their professional practice, and for this reason, for many years they have given great importance to in-service teacher training in project based learning and collaborative methodologies. On the other hand, the neighborhood in which the Center is located, belongs to the old area of Jaén, implies that the area is configured in a complex network of narrow streets.

The SCP is developed within a Center project related to energy reduction (50/50 project), in such a way that 50% of the benefits obtained throughout an academic year were dedicated to improving the Centre's energy efficiency. Between the months of October and December 2022, the Center opted to expand the project towards the field of waste management. Thus, the first step has been to identify recycling points in the neighborhood, detecting possible deficiencies and proposing suggestions for improvement to the council. Although the initial question was What can we do to encourage recycling in the neighborhood? it materialized into other more specific questions that could be addressed by the students: What do our neighbors need to recycle easily? How can we make the recycling points in our neighborhood visible so that people can use them? Are the recycling points adapted to the neighbourhood's needs? Who and how can we inform to repair the deficiencies in the neighborhood recycling points? How can we take advantage of the waste we have? Who can help us make musical instruments with recycled material? The teachers formulated the general question but, as the project developed, the students themselves suggested questions to be addressed with the intention of answering the initial one. Thus, the students were the ones that decides about which questions should be approaches and the means to solve them. They hope, in the future, to achieve economic benefits with recycling, which they will incorporate into the 50/50 project.

Specifically, the actors involved were early childhood education students (5 years old) and upper secondary students (14-15 years old), 3 teachers (one from Early childhood education and two from secondary education, one from Biology and one from Technology), "La Gloria" Neighborhood Association, "Fuente de la Peña" Residence for the elderly and the City hall. There was no previous relationship between the Center and the members of the community (Association and Residence) so this SCP has been an important starting point for future collaborations. The relationship with the elderly has been very enriching from different points of view since, on the one hand, their knowledge of musical instruments has been essential to design them with recycled objects and, on the other, the personal and human relationships generated in the visits have fostered mutual

respect and appreciation of the other generation. The neighborhood association "La Gloria" has developed cultural visits to the neighborhood, facilitating access to recycling points and allowing young people to get to know the neighborhood in depth.

Solution found:

- Location of the recycling points in the neighborhood (map), analysis of the situation and detection of deficiencies (locations that are not very accessible, number of containers not adapted to the real needs of the neighborhood, etc.)
- Preparation of an interactive map (My Maps) and brochures to locate recycling points in the neighborhood and distribution of information throughout the community (neighborhood shops, bars, restaurants, locals, nursing homes, other educational centers, etc. .)
- Inform the city council of the deficiencies detected and request for demands related to the improvement of the recycling points.
- Recycling of materials for the elaboration of musical instruments with the help of the users of the residence.

The solutions have been disseminated through QR codes and have been distributed by businesses and locals in the area. These QR codes directly access the interactive map to locate the recycling points, in such a way that the neighbors know the recycling points closest to their house, which is very useful because the neighborhood is made up of narrow alleys, which makes it difficult to direct visualization of the containers.

Thus, we believe that this SCP has become a success story for the city because it has been an advantage for the residents and it has allowed recycling points to be adapted to the real needs of the neighborhood.

https://www.google.com/maps/d/u/0/viewer?mid=15Ckk0tFspxug0JPMSL0ALUuyjlF1g-w&ll=37.757823628461765%2C-3.7938035000000037&z=16

Give a second life to your mobile- PEDRO POVEDA SCHOOL (JAÉN)

**The solution is in your pocket**

The Pedro Poveda School is a concerted Center with public funding with various educational levels: Early Childhood Education, Primary Education and Secondary Education. It is located in the southern area of the city of Jaén and carries out essential work there.

The SCP has been carried out by 43 students in the fourth year of Secondary Education (15 years old) together with 5 teachers and different members of the community, mainly relatives and acquaintances of the students, "Clean Point" Agency, town Hall and neighborhood Association. The students, organized by groups, have addressed the general question: how can we manage technological waste? Based on this challenge, each group of students, guided by their teachers, have decided to organize a collection of disabled mobile phones among their relatives and acquaintances. The collected mobiles were classified to be repaired and sold or to be properly recycled. Although the teachers raised the initial challenge, the students specified the actions to be carried out. First, they thought about what to do, enhancing the capacities of each member of the team. Some of them have designed posters to request help from other students at the Center, others students decided to collaborate in classifying the material, other groups committed search for people to

donate their mobile phones, and thus, collaboratively, all of them contributed to meet the proposed challenge. Thus, the students carried out multiple actions, among which we highlight the following:

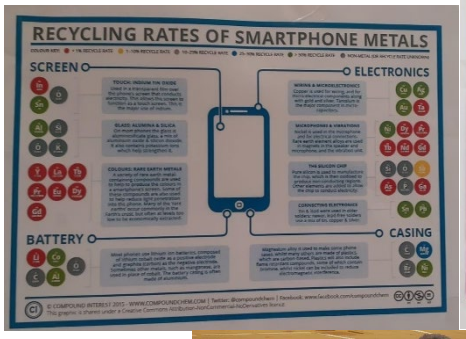
- Analysis of the origin of the problem, from environmental, economic, ethical and social points of view.
- Fine-tuning of the procedure to catalogue and organize the collected materials.
- Organization of a small business for the optimization of electronic devices: collection, recycling of elements, shipment for repair, sale, etc.
- The profits obtained will be dedicated to the energetic improvement of the Center.
- Dissemination campaign.

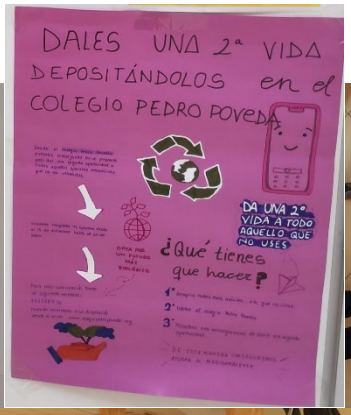
The solutions identified for the problem of technological waste management were the following:

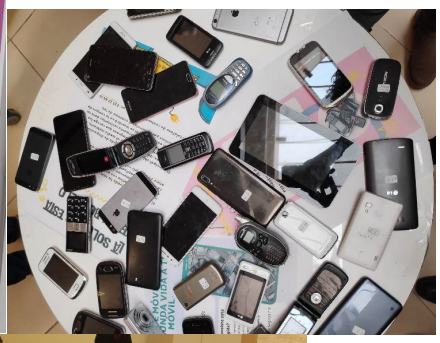
- Social awareness about the manufacturing process and about the use of electronic devices.
- Selective collection of electronic waste obtaining economic benefit.
- Positive impact on the energy efficiency of the school.
- Reduction of CO2 emissions: 1) management of the waste generated by electronic devices, 2) reduction of energy consumption in the Center.

This SCP will be continued in successive courses, in such a way that in the next academic year students will be guided to continue with the mobile repair and recycling campaign and the phase of improvement of the Center's energy efficiency will begin. It is expected that in this phase they will install light timers and electricity consumption meters, request and install photovoltaic panels, if possible, thus seeking for neutrality in terms of $CO_2$.
Students have disseminated the SCP through social networks and informing relatives and acquaintances

Regarding the obstacles, the beginning was uncertain, the students themselves thought of the project as a way of doing something different from their normal classes, but as the project progressed, and they saw that they had a leading role, they took the problem seriously and have become cognitively hooked on it. From their interventions, they explain to be interested in this type of project and specifically those related to caring for the environment. The students emphasize the importance of repairing and recycling mobile devices due to the scarcity of materials and the pollution generated by poor waste management.


RECYCLING RATES OF SMARTPHONE METALS
SCREEN
ELECTRONICS
BATTERY
CASING


DALES UNA 2ª VIDA
DEPOSITÁNDOLOS en el
COLEGIO PEDRO POVEDA
DA UNA 2ª VIDA A TODO AQUELLO QUE NO USES
¿Qué tienes que hacer?



## Sweden

### Wasteyards Safaris

Classes in all cohorts may book a Wasteyard safari. The classes are bussed out to a sorting yard where the children can discover the sorting yard's "Big Five"

The idea of these sorting yard safaris is for the children to learn in a fun way about recycling, waste, sorting at source, the cycle and what people can contribute to improving the environment.


BESÖKARE


BESÖKARE
BESÖKARE


Photo: Patrik Svedberg

Wasteyard Safaris has been running since the start of the MOST project and will continue in 2022. Until 2021, around 20 classes have participated in our SCPs and learned more about how we can improve the environment, valuable knowledge that children hopefully carry with them throughout life.

Here you can read more about Wasteyard Safaris and also book a visit. Link to another website, opens in a new window. See website above for direct links.

Media about Wasteyard Safaris Link to another website (Swedish TV), opens in a new window. See website above for direct links

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**Reduce littering at school**

The principal, teacher and caretaker at Rosenlundsskolan in Jönköping noticed that the littering of the schoolyards had increased, especially during the weekends. With this fact as a basis, a project started.

In May 2021, the students in year 4 at Rosenlundsskolantog, together with Marlene Svensson, waste educator from June Avfall & Miljö, produced sticky notes that were placed on the school's bins. In June, they also painted green footprints leading to the trash cans.

Already at the beginning of November, you can see an improvement with less littering.


Du, det är inte för sent
att hjälpa till att
hålla rent

**Waste films**

**Business-oriented students create waste films**

Young business-oriented high school students have competed with self-produced films in a film festival. The films are about how important it is to recycle waste - an important knowledge for students in their future professional lives.

Together with June Avfall & Miljö, high school students from Thoréns Business School in Jönköping have become acquainted with different types of waste at the sorting yard. After that, the students immersed themselves even more in waste management and formed groups that each present waste in a self-produced film. The films cover food and residual waste, metal, electricity, hazardous waste and plastic.

*Film festival*

The films participated in a film festival that the business high school arranged on Friday, September 25, 2020, where the film about residual waste was named the winner.

Watch the winning film here. Link to another website, opens in a new window.

*Important with waste management*

Some of the students chose Thorén's Business School because they want to study to become brokers and lawyers. They were a little surprised that waste management appeared on the schedule but now think that waste management can be linked to several topics.

- We did not know that there were such hazardous substances in electrical waste, says Absan Ahmed, who is in his first year of the Business Program. She points out that it is very important that we care about how we handle waste because it is harmful to humans, animals and nature.

- The biggest winner is the environment, according to Kristoffer Krantz, marketing manager at June Avfall & Miljö. According to him, cooperation with the younger generation on waste prevention measures is an investment in the future.

- Preventive work increases young people's sense of participation and responsibility at the individual level, which increases the chances that they will continue to work for a sustainable and circular economy, Kristoffer Krantz concludes.



**Solacars race 2021**

HLK contributed with a solar car race to the regional Climate Week
The University of Learning and Communication (HLK) at Jönköping University (JU) organized a solar car race for small cars during Climate Week in Jönköping County, 16-23 September.

Slideshow from the solar car race 2021 at Atteviks. More pictures exist on the webb, see link above in this document.

Climate Week is an annual event organized by the Climate Council in Jönköping County, which includes Jönköping University (JU). Climate Week aims for Jönköping to reach the vision of becoming a Climate-Smart Plus Energy County by 2045 by 2045.

A recurring activity during Climate Week is the solar car race, which this year is arranged by HLK through the project MOST. The competition took place at the car company Atteviks in Jönköping and high school students in Jönköping County who study technology were invited to participate. The students' self-built and maximum 15-centimeter-wide cars were powered by a battery that was charged with solar cells and sometimes during the competition day also by lights so that they would achieve full effect.

*The JU Solar Team sat on the jury*

The students were divided into a number of teams, which competed with their cars in three categories: Speed, innovation and design. The JU Solar Team had two seats on the jury that selected the winning entries. A total winner was also nominated and awarded the competition's hiking prize. It went to the team with Emma Liljedahl, Abbas Qhaimi and Filip Svärd at Aleholmsskolan in Sävsjö.

- I was a little unsure, but thought we had a chance to win and it was fun to come here and see the other entries in the competition, says Abbas Qhaimi.

He and his car-building colleagues made their car as light and stable as possible and that the weight was evenly distributed, which they emphasized in their presentation to the jury. They had also added a power button to save battery power.

"Technology education should be exposed more"

Emma Liljedahl, who was one of the few girls in the competition, was proud of the victory and the car that her team produced. She reads the technology program because she is interested in the subject and logical thinking in general. She thinks that technical education should be more exposed to girls and will after high school continue to study to be an architect.

Sara Sterne, chair of Girls in Stem (Science, technology, engineering, and mathematics) and who studies mechanical engineering at Chalmers University of Technology, was the project manager during the solar car race.

- I am here to get more girls to discover the fun of technology and all the good things you can do with technology, she says.

"Nothing stereotypically funny"

Sara Sterne mentions that the solar car race is not a stereotypical boy event and that more girls should have been there.

- We have not turned specifically to girls before the solar car race and unfortunately there are few girls in the technology classes who have come here. Girls often do not take up as much space as boys in such contexts. That is why it is important to show that technology events are not just for boys, she says.

*Teams of the year*

Aleholmsskolan, Sävsjö - 3 teams

Brinellgymnasiet, Nässjö - 3 teams

Finnvedens Gymnasium, Värnamo - 3 teams

Gnosjöandans Kunskapscenter, Gnosjö - 2 teams

Read more about Climate Week 2021. Link to another website, opens in a new window.

Read more about the Climate Council. Link to another website, opens in a new window.

*Media interest*

P4 Jönköping broadcast to and from during the day. Link to another website, opens in a new window.

SVT Jönköping was on site to interview students and Jesper Boesen from Jönköping University, who is responsible for the MOST project. Link to another website, opens in a new window.

SVT Jönköping also interviewed Sara Sterner, who led the day, about the network Girls in STEM of which she is a part. Link to another website, opens in a new window.

The SVT program Landet runt picked up the feature from SVT Jönköping. Approx. 9.55 into the program.

* Here you can read about the Solar Car Race 2019.

**Solar car race day**

As our first success story, we share an article on the solar car race day. This feature article is published in Swedish on our Swedish MOST site. We have made a simple translation from Swedish to English to give you a glimpse on one part of that SCP. The race day was covered by TV, Radio and newspapers.

*Solar car race 2022*
*Technical students competed in a solar car race*
*On Monday, October 17, the Solar Car Race started at the car company Atteviks as part of Climate Week. Technology pupils from the county's upper secondary schools were invited to compete with their cars in the categories Speed, Design and Innovation.*

*Climate Week runs between 17 – 23 October in Jönköping County with a variety of activities to provide increased knowledge and inspiration regarding the transition to a climate-smart society. A recurring activity during Climate Week is the Solar Car Race, which is led by the University of Learning and Communication at Jönköping University and the EU project MOST, in which Upptech also participates.*

*The jury consisted of representatives from Atteviks, JU Solar Team, Ung Företagsamhet and Solbilracet's project manager Jesper Boesen. The jury also awarded a walking prize which went to the team that was most successful in the sub-competitions.*

*In addition to being part of the jury, the JU Solar Team displayed parts of their full-size solar car and answered questions from the students. They build the solar car themselves and will compete next year in the Bridgestone World Solar Challenge in Australia.*

*There was a good atmosphere at the competition and the happiest was probably the team with Filip Andersson, Jesper Johansson and Mohammed Al Daabais from Aleholmsskolan in Sävsjö, who won both the speed prize and the walking prize with their car, which they have aptly named the Turbo car.*

*- It has been a great day and we are glad that we won so much. The race was quite even, but our car went very straight, which is probably why we won. We built the car in school before the summer*

*holidays, but there has been some work with it outside of school as well. We did a 3D-print of the car's chassis at home, they say.*

*Jesper Boesen, director at the University of Learning and Communication and project manager for the second year of the Solar Car Race, is satisfied with the event.*

*- It is fantastic to see the enthusiasm and commitment from the students. I think events like this are important for several reasons. It's genuine learning joy, where students have fun and learn about solar cells and the environment, he says.*

*See also for more pictures and media coverage: Solbilsrace 2022 - MOST - Jönköping University (ju.se)*

**Wastefilms 2023**

The second success story is also covered in a feature article on our Swedish MOST site

*Waste films created by pupils at Thorén Business School*
*Young business-oriented upper secondary pupils have competed with self-produced films in a film festival. The films are about the importance of reduce, reuse and recycle - important knowledge for the students in their future professional life.*

*Upper secondary pupils in year 1 from Thorén Business School in Jönköping, have become familiar with different types of waste during a study visit to the waste yard. The students have immersed themselves even more in waste management and formed groups that present one type of waste each in self-produced films.*

*The project has resulted in five films about residual waste, metal, electrical waste, dangerous waste and plastic. During a closing film festival, the groups presented their work and their film.*

*A jury of representatives from the University of Learning and Communication at Jönköping University, Upptech, Thorén Business School Jönköping and June Waste & Environment, selected a winning film, which was a film about residual waste.*

*The project is one of several SCPs (School-Community Projects) in the MOST project, which stands for Meaningful Open Schools To Communities, which is an EU project.*
See more for pictures, films etc: Avfallsfilm 2023 - MOST - Jönköping University (ju.se)

## Turkey

### Increasing awareness about alternative energy sources

Students aimed to determine community members' awareness about alternative energy sources and provide them information about alternative energy sources including research and innovation in this field.

The students held an online meeting with a science teacher, assistant principal, parents, and an electrical engineer who was responsible for alternative energy sources used in Van province. Based on that meeting, students constructed their interview questions to discuss with the community members. The questions are below.

- What is the renewable energy source?
- What is the most used renewable energy source in Turkey?
- How many kW of electrical energy can a standard solar panel generate on a sunny day?
- Do you save energy in your home? If do not, what can you do?

Each student in the SCP contacted some community members and carried out interviews. The students asked the interview questions and after the given answer they gave information about the answers of the questions.

What is the renewable energy source? The questions and given main information are below.

What is the renewable energy source?

*The students explain what renewable energy and renewable energy source are after given explanations.*

What is the most used renewable energy source in Turkey?

*The students give information about the percentages of used renewable energy sources in Turkey in terms of given answers.*

How many kW of electrical energy can a standard solar panel generate on a sunny day?

*The students give information about the size of standard solar panels, generating electrical energy in one hour on a sunny day, etc.*

Do you save energy in your home? If do not, what can you do?

After the interview, the students attended the online interactive MOST fair and shared their experiences with the participants.

This SCP has a success story since the students behaved as science citizens and science communicators. The awareness of community members and their knowledge about alternative energy sources were increased in this way.

**Possible alternative energy sources for school and home**

Students investigated the process of generating electrical energy with solar energy systems at schools and homes. They focused on calculating the cost of constructing solar energy systems in schools and homes.

The SCP leader followed the INCREASE road map to carry out the SCP. In line with this, the leader invited community members, electrical engineers, mechanical engineers, and workers in a company that serves in the energy field and installs energy panels. For the co-creation stage, two online meetings were carried out. The stakeholders and the students reflected on the importance of energy saving, the energy production methods widely used in Turkey, and installing solar panels in a building in the first meeting. Some stakeholders and the students studied the cost of the solar panel system, the needed panel amount, school electric bills, and time for gaining profit from the system in the second meeting. The stakeholder displayed the preliminary work for the system. A picture of the system is presented below.

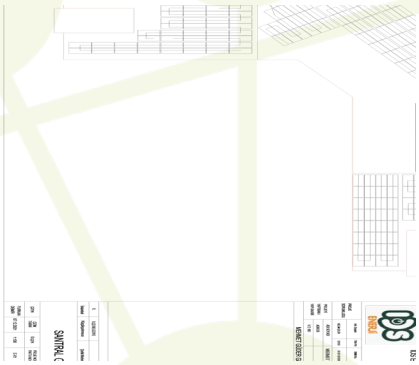

*Figure 1. School solar panel system*

In the Act stage, the students collected their school and home's electric bills, examined their school construction plan to calculate the size of its roof, and calculated the size of their home roof. After that, they calculated how many solar panels would be needed for their schools or homes to generate needed energy. They calculated the cost of the number of solar panels, compared the cost of the electricity consumption, and calculated how long it would take to cover the costs and move to an advantageous position.

The students presented their results in an online interactive MOST fair and evaluated the project process.

This SCP has a success story since the students worked as engineers on a daily life problem and reached real results. behaved as science citizens and science communicators.

**Investigation of waste oil amount**

In this SCP, students tried to determine the amounts of waste oil produced at homes and calculated the average amount of waste oil that a person produce in one year.

The students were brought together with stakeholders who are a manager of a chamber of commerce and industry, two people from NGOs related to the environment, and community members, in a meeting for the co-creation stage. They discussed what waste oil is, the production of waste oil in the food sector, industrial sector, and homes, the responsibility of the municipalities for collecting it from home as well as decided to investigate it for homes.

The students collected data during five days and analyzed this data. Students calculated the average amount of waste oil that one person produces in one year based on the data. The result shows that one person can throw or accumulate an average of around 1 L (956,665 mL) waste oil in one year.

The SCP leader presented the SCP process at the International STEM Education Conference and the students shared their results in an online interactive MOST fair and evaluated the project process.

This SCP has a success story because the students worked effectively with people from the industry, NGOs, and the community. Additionally, the results and process of the SCP were announced to large audiences.

**Paper Napkin Project**

**The aim of the SCP**

It was aimed to calculate how much energy and financial savings could be achieved by using a dryer instead of paper napkins at school and to create awareness of energy saving.

**Community Dimension of the SCP**

- Preventing the increasing cost of paper napkins at school,
- Reduction of wood consumption
- Reduction of carbon emissions
- Establishing a relationship between efficient use of energy and ecological balance
- Creating awareness of saving by observation and research

The prominent features of the project

- Establishing cooperation between the school and the company during the project process.
- The company donated four drying devices to the school.
- The school's budget allocated for equipment purchase was used to meet the school needs of girls.

- The meeting with the company officials shaped the research process.

**Invite**

In the project, 10 students and five stakeholders participated voluntarily. The school's science teacher, math teacher, vice principal, and electricity company officials were the stakeholders.

**Co-create**

Two online meetings were held during the co-creation stage. In the first meeting, the following items were discussed.

- Napkin expenses of the school,
- Materials used in napkin making,
- Damages to nature caused by the use of napkins,
- Electricity consumption cost of electric hand dryers,
- Comparison of napkin sustainability and electrical energy,
- Carbon emissions,
- How the paper napkin and hand dryers can be compared in terms of energy consumption?

In the second meeting, energy efficiency and the advantages of these dryers in terms of energy consumption were discussed with the official of the donor organisation.

**Act stage**

Observations were made, and data were collected on the use of paper napkins in the toilets as girls and boys groups. The average number of napkins used was found, and the average annual cost was calculated by researching the price.

Kross Electric Company, which sells hand dryers, was contacted and informed about the project. The company donated hand dryers to the school.

The average drying time was calculated by observing, and the average annual electricity cost was calculated.

The average annual cost of paper napkins for the school is 44300 Turkish liras (2200 Euros)

The annual energy consumption of the devices is 136,5kW

Average annual energy consumption cost of the devices (446 Turkish liras) (22 Euros)

**Share**

The results obtained were presented the MOST Fair held on November 26-27, 2022 and on the school notice board.

**Evaluate**

With the transition from using paper napkins to drying devices at school, 0.6 tonnes of paper will be avoided. In this way, approximately ten trees will be saved, 45000 lt of clean water will not be polluted, 1.8 tonnes of $CO_2$ will not be emitted, and 16.2 m3 of waste space will not be used.

**Energy Savings in Underground Naturally Cooled Warehouses**

**The aim of the SCP**

In the project, it is aimed to compare the current status and characteristics of naturally cooled underground warehouses in Cappadocia province and the energy costs of natural storages with thermally cooled storages.

**Community Dimension of the Project**

- Impact of naturally cooled underground warehouses on the environment,
- Environmental impact of naturally cooled underground warehouses,
- Cooling costs of thermally cooled warehouses,
- Environmental impact of thermally cooled warehouses,
- Contribution of naturally cooled underground warehouses to regional employment.

**Invite**

In the project, 11 students and nine stakeholders participated voluntarily. Science teachers, owner of naturally cooled underground warehouse, owner of thermally cooled warehouse, the school principal and academicians were the stakeholders.

**Co-create**

In the online meeting attended by the stakeholders, information on warehousing activities in the region was discussed. In addition, it was planned to carry out research on the products stored in naturally cooled underground warehouses, cooling energy costs of naturally cooled underground warehouses, the conditions required for long-term storage of stored products, energy costs in aboveground warehouses to create storage conditions for products.

**Act stage**

Data were collected from warehousing stakeholders and managers of warehouses in the region.
The general characteristics of the warehouses, cooling systems, their susceptibility to daily and seasonal temperature changes, humidity levels, annual electricity consumption of natural underground and thermally cooled aboveground warehouses were determined.
Data were collected on the products stored in the warehouses and the storage periods of the products.

**Share**

The result that the energy costs of natural warehouses in the region are very low compared to thermally cooled warehouses was shared on the boards in school and on various social networks.
The results were also presented the MOST Fair held on November 26-27, 2022.

**Evaluate**

The underground warehouses carved into the tuff rocks in Cappadocia province create a warm environment in winter and a cool environment in summer.
In these warehouses, only the cold air of the warehouse is utilised without using any equipment to cool the environment. In addition, there is no loss in the products other than the damages caused during collection and transport, and due to its properties, such as constant temperature and humidity balance, the natural structure of the stored products is preserved without deterioration.

## Solar Energy Source of Our School

### The aim of the SCP

In the project it is aimed to investigate how much solar panels benefited from solar panels in the solar panel established school, the amount of energy produced and energy marketing.

### Community Dimension of the Project

- Opportunities to utilise solar energy as an alternative energy source,
- Economic profits related to energy production and marketing,
- Gaining awareness about solar panels.

**Invite**

In the project, 10 students and eight stakeholders participated voluntarily. Some students from different educational levels interested in the subject also participated. Energy engineer and solar panels company, science teachers, pre-service science teachers, academicians, school administrators, parents, and visiting students were the stakeholders.

**Co-create**

The research process of the project was planned together with the stakeholders in an online meeting. In addition, the following issues were addressed.

- The amount of energy consumed by our school per month,
- Selection of solar panels,
- The number of solar panels needed to generate all energy from the sun,
- The area of the school roof,
- Calculation of how many panels can be used on the school roof,
- Points to be considered in the placement of panels.

**Act stage**

The number of solar panels was calculated according to the amount of energy our school needs per month. During the calculations, the required number of solar panels with dimensions of 1665 cm x 996 cm on the roof area of 1617 $m^2$ was determined as 570. The information obtained from the stakeholders that the school consumes an average of 14,577 kW of energy per month, and graphs of how much energy was saved thanks to solar panels were drawn. While saving energy, at the same time, the profit from the electricity generated is determined.

**Share**

The students both informed their close environment about the ways in which the energy needed is obtained from solar panels and shared information about the ways to be followed for energy saving. The results were also presented the MOST Fair held on November 26-27, 2022.

**Evaluate**

During the project process, it was evaluated how alternative energy produced by solar panels could be gained, the project process and whether the project achieved its objectives.