D3.1 METHODOLOGICAL PROTOCOL TO GENERATE TRANSFORMATIVE EOC ACTIVITIES DESIGNED FOR SPECIFIC AGE GROUPS

Project acronym: OTTER

Project title: Outdoor Science Education for a Sustainable Future

Call: H2020-SwafS-2018-2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 101006482

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OTTER project

OTTER is a H2020 funded project that aims to **enhance the understanding of Education Outside the Classroom** (EOC) **methods and pedagogies** and how they can help **improve the acquisition of scientific knowledge and transferable skills in students**, **specifically in the field of environmental sustainability and the reduction of plastic waste**. It aims to increase interest in scientific topics among young people, while also contributing to the range of innovative educational projects and the increase of scientific citizenship within the EU.

OTTER aims to strengthen educational outside-the-classroom (EOC) **networks within Europe**, connecting experts from four different regions within the continent (**Finland, Hungary, Ireland and Spain**). The strengthening of these networks will be utilized to conduct a program of EOC pilot schemes and analysis of the effect they have on the performance of participating students, including their levels of sophisticated consumption and scientific citizenship, to increase understanding of the effects of education outside the classroom on EU students and citizens. The pilot schemes will share a common theme revolving around issues of plastic waste and recycling to build upon recent momentum in tackling related global educational, social, and environmental issues and due to the close relationship between reducing plastic waste and the need for more sophisticated consumers.

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Project Consortium

Geonardo Environmental Technologies **(GEO)**

European Science Foundation **(ESF)**

University of Groningen **(RUG)**

University of Limerick **(UL)**

Bridge Budapest **(BB)**

Learning Scoop - oppimisen osuuskunta **(LS)**

The Big Van Theory **(TBVT)**

Center for the Advancement of Research & Development in Educational Technology **(CARDET)**

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1. STARTING POINT OF THE METHODOLOGICAL PROTOCOL TO GENERATE TRANSFORMATIVE EOC ACTIVITIES DESIGNED FOR SPECIFIC AGE GROUPS

1.1 First proposal for the methodological protocol

This first version of the methodological protocol of OTTER outdoor activities has been generated considering the conclusions and key findings of D2.1 Literature review and compendium of successful practices, the expected impacts of the project description as well as TBVT experience, as coordinators of the task.

TBVT generated a Methodological protocol based on 5 steps as shown below. This protocol, with two practical examples, was shared with the partners in charge of the implementation of OTTER outdoor labs (UL for Ireland, BB for Hungary, LS for Finland) and reviewed in a meeting.

1.2 Steps of the methodological protocol

	Pedagogical objetives and model definition	Places to develop the outdoor activity	PRE-LEARNING	Outdoor Activity	POST-LEARNING
DAY 1					
DAY 2					
DAY 3					
DAY 4					
DAY 5					

STEP 1: PEDAGOGICAL OBJECTIVES, CONTENT AND SKILLS

1.1. Model: The OTTER outdoor labs can follow several learning models, but incorporating all these three to achieve the “Expected Impacts” of the project:
1) learning by doing (moving and hands-on activities),
2) collaborative learning (affective and social skills acquisition) and
3) experimental design and inquiry-based learning approach (writing research protocol, creating scientific mapping, drawing, and disseminating conclusions).

1) Learning by doing correlates with learning by moving and hands-on activities which increases students' well-being and engagement in learning thanks to the benefits of the outside activities. Learning by doing is based on the idea that we learn more when we actually “do” the activity. We learn best when we can participate and be active in our own

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learning. Furthermore, learning by doing increases learners' well-being. It creates positive emotions and helps learners to develop valuable social-emotional skills. Moreover, learning by doing has many benefits when implemented outdoors. Outdoor activities in nature promote the overall well-being of students. In nature, the mind becomes peaceful and relaxed, and heart rate, blood pressure and stress are reduced.

2) Collaborative learning helps students to acquire new affective and social skills and to get familiarized with collaborative methods. By doing common activities, students socialize better and develop social and communication skills, such as: compassion, empathy, teamworking, tolerance. Collaborative learning means sharing the responsibility for learning within a group to achieve a shared goal. In this model, each member contributes to the group's learning, and the group supports each individual's learning. Positive co-dependence is at the core of collaborative learning. This concept is based on the idea that the group has a united focus and that the members need each other to achieve the goal. Moreover, collaborative learning requires copious amounts of interactive communication. Collaborative learning helps students to acquire and fine-tune affective and social skills as well as get familiarized with collaborative methods and teamwork. Collaborative learning has many benefits: it promotes problem-solving skills, increases motivation and self-esteem, and creates a positive atmosphere to the class etc.

3) Experimental design and inquiry-based learning approach: This approach supports students to better understand and choose scientific disciplines by drafting research protocol, creating scientific mapping, drawing, and disseminating conclusions, identifying, and controlling emotions, collaborating with peers, or developing imagination and critical thinking. Experimental design and inquiry-based learning approach help students to understand the process of scientific research. Inquiry-based learning is an activating learner-centered process based on students' own work and research. The aim of the method is to be able to understand and explain a phenomenon or a problem. Inquiry-based learning consists of several distinct phases: 1. Setting up the context, 2. Presenting research problems, 3. Creating working theories, 4. Critical evaluation, 5. Searching deepening knowledge, 6. Developing deepening problems, 7. New theory, and 8. Publication of results. Distributed expertise is part of all the steps. The students work together and share their perceptions and knowledge throughout the process.

At its best, inquiry-based learning is a research process that creates both new understanding and knowledge. Seeking, structuring, and sharing new information together as a social group is essential. Experimental design supports students to better understand scientific disciplines by drafting research protocol, creating scientific mapping, drawing, and disseminating conclusions, identifying, and controlling emotions, collaborating with peers, or developing imagination and critical thinking.

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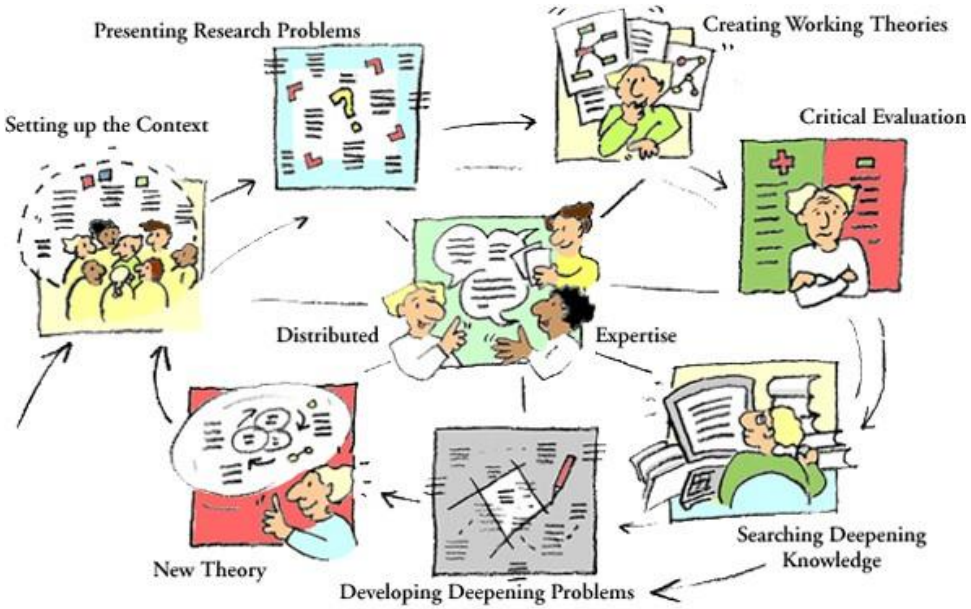

Figure 1: Inquiry-based learning model

1.2. Select the content: According to the curriculum, appropriate selection of teaching content is important for pre- and post-learning. To correlate the outings with the curriculum facilitates the possibility of having these outings in schools with restricted time for non-formal activities. The contents of the EOC Lab should be based on each country's curriculum. The contents should preferably combine elements of several school subjects, especially science, mathematics and art. Contents should be relevant for sustainable development, understanding environmental problems and reducing plastic waste. The contents should also be easily linked to meaningful EOC activities.

1.3. Select the skills: According to the curriculum's finalities, it is important to design the outdoor experience. The skill's selection should be specifically adapted to the age range and the school needs. Deciding what skills are specifically developed through EOC Labs should be based on each country's curriculum. The skills should also be relevant when solving environmental problems and developing active citizenship.

1.4. Gender approach: Be aware of gender differences in nature-based learning approach and environmental awareness to develop the activities. Consider a specific reflection workshop about eco-friendly behaviors in both men and women. When developing the more detailed pedagogical model for each age group and each country, the gender perspective should be considered. It is important to plan how to encourage both boys and girls to become environmental agents.

STEP 2: PLACES TO IMPLEMENT THE OUTDOOR ACTIVITY

2.1. Select meaningful places according to the content and skills: The ideal choice will be learning in nature, joining existing initiatives or creating our own ones. In this sense, it would be useful for schools to have a list of existing initiatives they can join.
Other approaches are science camps, science exhibitions, research centers, and companies that work for sustainability. According to OTTER Expected Impacts, the place where to develop the activity should encourage cleaning up our planet and reducing levels of plastic waste.

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2.2. Co-creation with students: Students should be actively involved in the activity design and location selection.

2.3. Financial resources for the school, as well as time restrictions: these are factors that affect which locations are selected and suitable for the EOC activity.

STEP 3: PRE-LEARNING

This step includes session(s) organized before the on-site activity in which:

- The goals and learning outcomes should be explicit and made clear to students. In this way, the **pedagogy of astonishment** developed by Louis Legrand in France will be experienced.
- The learning is linked to the established curriculum in several subjects.
- The pre-learning activity should incorporate:
    - mapping students' prior knowledge about the topic
    - setting learning goals with students
    - orientation to the up-coming EOC activity

Teachers need support and continuous professional development to enable them to effectively scaffold students pre and post learning

STEP 4: OUTDOOR ACTIVITY: DISCOVER!

During this step, several activities can be organized:

- Learning by doing and collaborative learning.
- Resources collection to continue their learning into their classroom.
- Experimental design and inquiry-based learning approach.

STEP 5: POST-LEARNING

During the post-learning, session(s) to enhance learners' existing knowledge can be organized.
During the post-learning step, the protocol should include the A on STEAM by creating concept map, debate, presentations, role play, narration, illustration, video creation, music composition. These sessions should promote creativity, artistic disciplines, exploration, and collaboration.
On the post-learning students should be encouraged to become “changemakers”, to reflect on how this knowledge can help to change the world around, promoting a volunteer attitude.
The methodology will be adapted according to the specific needs of both students and teachers.

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Examples

Example for age range 9-12

1.- Teachers set the pedagogical objectives and models

- To be aware of how rubbish enters the marine environment and how this can be avoided
- To consider how rubbish can impact the environment and wildlife.

Model:

- SYSTEM THINKING: My actions locally affect the environment globally
- LEARNING BY DOING:
- EXPERIMENTAL DESIGN:

2.- Place selection

In Barcelona there are some existing initiatives to clean the beach, as:

- World Cleanup Day
- Waste free project

If the school decides to join any of these, teachers should schedule a day for the outdoor activity together with the organization that offers it (museum, NGO, company, etc.) and think about transportation and possible fees.

3.- PRE-LEARNING

Should be implemented during class time.
1.- Discuss with students where they think rubbish goes once it's thrown away. What happens if it gets into the environment?
2.- Have a look at different snacks or drinks students have and discuss where they should be put afterwards – recycling/rubbish bin?
Watch the video as a class and then get students to complete the worksheet. Teachers may want to play the video once before replaying & pausing/discussing to allow students to retain the information.
Discuss how rubbish from a landfill can end up in the ocean – wind/storms.
Video: http://bit.ly/littertosea
Worksheet: "Now you've watched the video try to remember 3 ways rubbish can get into the sea".

4.- OUTDOOR ACTIVITY

Join the waste free project.

5.- POST-LEARNING

REFLECTION:
ARTISTIC OUTPUT: Students can make a leaflet/poster informing people on how rubbish gets into the ocean and ways in which they can prevent it from happening.

Example for age range 16-18

1.- Teachers set the pedagogical objectives and models

- Describe and analyses artists' work, understand how plastic pollution influences their work and how visual art can express feeling, present ideas and solve problems.

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- Develop a personal piece of art using plastic, which main objective is to raise awareness about plastic pollution.

2.- Place selection

An exhibition of Liina Klauss, an artist that wants to raise awareness about plastic pollution.

3.- PRELEARNING

Discuss with students what they think of plastic pollution, in what forms have they seen it, what adjectives would they use to describe it? Have they seen examples of plastic pollution art before and if so, what did they think of it? What can we do with plastic debris to create art? What are the benefits of plastic pollution art? - Raises awareness, inspires action
As a class, look through the artists' work, everything using plastic. There are a variety of artists listed below who focus on different art forms:
Arrangements/Photography - Richard Lang & Judith Selby Lang
Photography – Mandy Barker
Photography/Film - Chris Jordan – WARNING, this presentation includes photographs of albatross remains
Installations/Mosaics – Liina Klauss
'Trashion'/decorative art – Marina DeBris
As we will visit an exhibition of Liina Klauss, they should start their artist research using the internet or information on the presentation, this may be completed at home. They should aim to include the following:

· Artist information – location, dates of work
· Images of their work – can print in school or at home
· Techniques and inspiration – what media do they work with? What is the main style and characteristics of their work? What influenced their work? Colours (can include a swatch), shape, composition/pattern, message, context? How do they use plastic in their work?

– How does the artist aim to raise awareness of plastic pollution? Do they involve members of the public in the process of creation? What feelings does the art evoke? How has it inspired them and how does it link to their idea? What can we do with plastic pollution art to raise awareness?

Students can complete this as individual work or work through these points as a class.

4.- OUTDOOR ACTIVITY

- Liina Klauss exhibition in the museum
- The outdoor activity can be completed with a walk in the natural/ marine environment nearby the school to collect plastics. These plastics can serve as materials for their own pieces of art.

5.- POST-LEARNING

Reflect on how plastics are changing the way we interact with the environment
Create their own exhibition using plastic. Selection of materials – this may include plastic pollution collected from the natural or marine environment, a collection box at home or school, etc.

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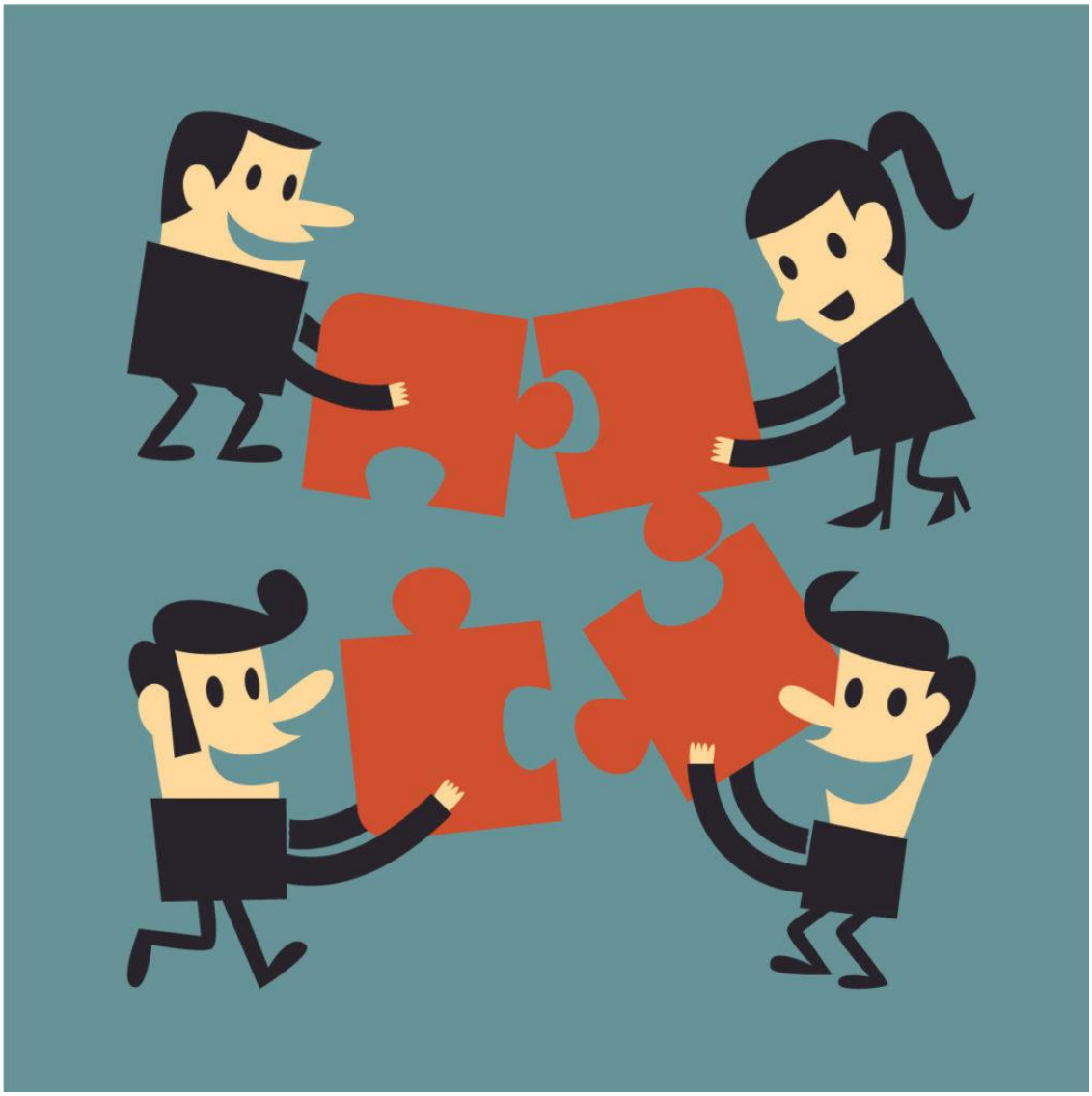
2. CO-CREATIONAL SESSIONS WITH TEACHERS TO ADAPT THE METHODOLOGICAL PROTOCOL TO DIFFERENT AGE RANGES



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2.1 Learnings obtained after cocreational sessions

Each partner implemented a round of co-creational sessions with teachers from different educational levels to share this first protocol and to reflect on how to adapt and improve to the different age ranges.

2.1.1 LEARNINGS FROM IRELAND

Age Range: 6 to 9 years old

Feedback from primary teacher on education outside the classroom
Current practice
STEM is central to the work of the school, with the school attempting to focus on carbon footprints and sustainable development goals. The school has an outdoor classroom which supports with learning in a variety of ways:
Exploring the seasons
Fruit and veg beds/garden
Bug hotel
Frog life cycle
Weather station: which works really well

The school already engages with a number of trips to the local city, with local cultural activities (Street Theatre and life of animals/habitats) and making movies about spring in the outdoor classroom

What works from the teachers experience in EOC
Outdoor task needs to have a clear purpose
Each student has a clear role in the activity
Activity has a clear parameter and some structure, while giving students freedom to be creative
A product at the end of the task to highlight student work/achievement (Having a media focus (imovie) works well with students)
Provides clear and easy resources for teachers to use
Provides clear links with other subjects
Uses language teachers recognize (encourage engagement from teachers resistant to change)

What to avoid
Tasks and activities that are overly vague
Including too much new complicated vocabulary
Potential issues/difficulties:
Space and access to the outdoor classroom can be a difficulty at times, with nearby classrooms being disturbed.
Additional support could be provided in the areas of Engineering and technology, as the focus can be more on science and math in STEM – physics and chemistry could be enhanced also? (Just to note this teacher has expertise in math education)
The teacher would welcome ‘guidelines on linking the inside classroom to the outside classroom’
Would benefit from learning more about pre and post learning and strategies to support this.

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2.1.2 LEARNINGS FROM FINLAND

Age Range: 9 to 11 years old

NAME OF SCHOOL: Atalan koulu, Tampere (Atala School, Tampere)
Atala School is a primary school for about 400 students (grades 1-6 and pre-primary classes) in Tampere, Finland's third largest city. It is located in a suburb surrounded by forests and nature reserve.

NAME OF TEACHER: Kaisa Tuomarla, Master of Education, Bachelor of Early Childhood Education
Kaisa Tuomarla has worked as a class teacher over 20 years (grades 1-6 and all subjects). Her work has included leading several projects about team learning and developing global education and multicultural education materials.

First note: The steps of the pedagogical model don't necessarily need to be in this order! It depends totally on the object and the content of the project! The steps from 1 to 4 can change their places. For example, the step 3 pre-learning can be before step 2. In addition, sometimes step 4 can be the first one. If a teacher has a good idea about an activity, learning process can start with that. This requires that the teacher has internalized the curriculum and its objectives and has a strong pedagogical expertise.

Second note: One of the pre-arrangements should be checking if this EOC project can be done in collaboration with one's colleagues. This increases the quality of the project, helps in planning and implementation, etc. It should also be considered if the developed EOC project / activity could be shared for example with all the grade 4 classes in one school. The education for sustainable development should be something that the whole school commits to!

1. PEDAGOGICAL OBJECTIVES, CONTENT AND SKILLS

Questions to teachers and/or students:
What are the possible pedagogical objectives you can cover in an environmental outdoor activity, according to the curriculum?
The whole curriculum! Basically, all the contents can be learned outside the classroom. For example, for this age group the following subjects (and many of their objectives) have been easily turned into EOC learning and environmental activity: mother tongue, foreign languages, science, math, history, religion, PE, art, music, etc.

What skills can be covered that are especially relevant for this age-group (9–11)?
Social skills, collaboration, teamwork abilities, tolerance, understanding different viewpoints, creativity, critical thinking, problem solving, seeing a phenomenon as a part of larger entities, etc.

Have you noticed any difference related to environmental behavior between boys and girls?

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There is a bigger difference between different age groups than the genders. Maybe at the age of 11 the girls are a little bit more aware of the environmental issues than boys. But there is no difference between the attitudes, etc.

If so, how do you handle it?
By increasing awareness of sustainability, eco-social issues, etc. Especially introducing sustainable topics in everyday schoolwork: recycling, reducing food waste, saving electricity and water, etc. It is a natural part of their everyday work and action.

2. PLACES TO IMPLEMENT THE OUTDOOR ACTIVITY

Questions to teachers and/or students:

What kind of activities do you think you can implement to co-create the session with students?

Places to implement the outdoor activity: EOC can and has been implemented everywhere, for example: in school yard, forest, in lake shores, in nature in general, museums, theaters, city centers, churches, libraries, companies, workplaces, sport clubs, nature schools, NGOs, sport facilities etc.

Note: During the co-creational session the teacher suggested that one more step could be added to the methodological protocol:

X. HOW TO INVOLVE THE STUDENTS IN PLANNING THE EOC ACTIVITY

Students can be engaged in developing and planning the EOC activity in many ways. For example, the students can be involved in choosing a suitable topic for EOC activity. Pupils can also give suggestions on the methods / activities implemented during the EOC project. If the teacher already has the objectives and contents chosen, the students can suggest suitable locations etc.

Methods to plan outdoor lessons with students: class meetings, group designs, pair discussions, idea mills with sticky notes, learning cafes and other co-operative teaching methods.

3. PRE-LEARNING

Questions to teachers and/or students:

How much time do you normally invest in the pre-learning?
It depends on the project / activity and especially the scope of it! From fifteen minutes to 2 hours. (In larger learning modules even ten lessons!) If a topic is new to the pupils, more time will be needed for pre-learning.
How much time is the maximum you can invest?
Depends on the activity and how much it covers the curriculum. At minimum, a teacher can teach new topics in math inside and then the rest of the lesson is held outdoors with books – just a normal math lesson but outdoors. If one wants to deepen the learning around a certain phenomenon, pre-learning is an important step before the activity which usually takes at least two lessons. Half an hour pre-learning before 1,5 hours outdoor activity is a good basis.

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How many different subjects/ curricular areas are normally involved in an outdoor activity?
It depends on the activity! From 1-4 subjects are usually involved in one outdoor activity. (Basically, all the contents can be learned outside the classroom. For example, for this age group the following subjects have been easily turned into EOC learning: mother tongue, foreign languages, science, math, history, religion, PE, art, music, etc.)
Is it transversal or linked to one teacher/subject?
Both! Transversal competencies are easily learned in EOC activities (in fact EOC always supports the learning of transversal skills). Sometimes an EOC activity is linked to one specific subject.
Note: The purpose of pre-learning is to promote *learning*! That means orientating to the new topic, mapping pre-existing knowledge, setting research questions for the actual EOC activity etc. Pre-learning activates pupils' prior knowledge and helps them to make the right connections between new knowledge (acquired during EOC activity) and pre-existing notions. This way new information is easier to understand, and it becomes relevant to pupils. Keeping the activity as a secret or as a surprise denies pupils to do research and work as active learners – which is one of the main goals of STEAM.

4. OUTDOOR ACTIVITY: DISCOVER!

Questions to teachers and/or students:

Imagine the perfect outing:
What kind of place is it?
What are the activities you do?
Who do you interact with?
How do you have fun?
What kind of things do you learn?

An example of a perfect EOC activity with a class (10 years old children):
It took place in the city center of Tampere. We used students' own mobile phones. They had an app called Loquiz. Loquiz is an outdoor game, working with gps. This Loquiz Game we used was made especially for children of this age and it included questions, challenges and tasks of the places we visited. Tasks and questions included topics about history, geology, biology, art and math. Challenges demanded skills in PE and art. It was like an Amazing Race, but with the whole class (walking the route with their teacher). We interacted with the church verger and of course the app was interactive itself. During the race we stopped to eat lunch. The race was very motivating and fun for students. Afterwards we discussed the tasks and learned more about the topics in the classroom and made further investigations of them.
Once again, the key question is: what kind of activities *promote learning*? The ultimate goal is to learn new things, and everything should be planned and implemented from that perspective. It is ok to have fun, but that is not the only objective. When students are engaged in meaningful learning, they usually experience the feelings of excitement, shared understanding, and joy.

5. POST-LEARNING

Questions to teachers and/or students:

What kind of activities do you use for the post-learning?

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There are plenty of suitable reflection methods in LessonApp (a mobile tool developed for lesson planning), https://lessonapp.fi/
Examples of the methods used in post-learning: 1-2-3, Posters, Bus stop, Numbered Heads together, Buzz Groups, Gallery Walk, Learning Journal, Snowball, Three words, Voting etc.

Note: The purpose of pre-learning is to promote *learning*! The post-learning should include deepening the learned new topics, reflecting the whole learning process, analyzing what has been learned and what we still want to learn, setting new learning goals for the future etc.

"Reflection is thinking about and analyzing your own learning. Reflective learners process their learning, relate it to what they already know, adapt it for their own purposes, and translate thoughts into action. Reflection develops creativity, ability to think critically about information and ideas, and metacognitive skills (ability to think about one's own thinking). Furthermore, reflecting one's own learning enhances deep learning. Through reflection new knowledge is adhered to one's own knowledge structure and is more easily remembered afterwards." LessonApp: Reflection and Evaluation.

6. BARRIERS

Questions to teachers:

What kind of barriers do you have to organize an outdoor activity in your school?
- Rigorous curriculum. - Not a problem in Finland. The current curriculum for basic education supports strongly this type of teaching and learning.
- Time-consuming for teachers - Yes. The collaboration with colleagues helps this. Also sharing great plans with your colleagues in your own school and also with other schools.
- Children supervision - Not a problem in Finland. Students are used to this type of studying. They are taught the needed skills already from the early childhood education onwards. Also, parents consider EOC activities as a normal part of the schoolwork.
- Measure and monitor the knowledge acquired - The evaluation and assessment in Finland is already versatile using different evaluation methods. So, it is no different in the case of EOC activities. The evaluation is often linked to the post-learning session when the teacher assesses whether the learning goals are achieved. Moreover, for example self-assessment and pair-assessment can be used.
- Financial issues - In Finland basic education is free of charge. Sometimes there may be financial issues depending on the EOC activity and how it is implemented (for example travel costs etc.). Environments nearby the school (forests, school yard, libraries, museums etc.) are always available without extra costs.

What special support you may need?
This is a fairly standard part of Finnish school work, and done all the time, so no special support is needed.

Would it be valuable to have a list of environmental initiatives/ entities you can join?
Yes, definitely. The list could be also supplemented by teachers, so the list could be expanding.

Main conclusions of co-creation session
1) One model does not fit all. Could we offer 2–3 different pedagogical models for each age group? One model could be for those teachers who are not remarkably familiar

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with EOC and want an easy model to start with. One or two models could offer an EOC framework for those teachers who already have experience in EOC and want to develop their EOC practices further. These different models would be more easily adopted to different countries and no country-specific modifications might not be needed.

2) We need to tie the developed pedagogical model to the concept of learning (e.g., socio-constructivist view of learning). All phases of the model need to be based on the modern research on learning.
3) The developed model should encourage and give practical examples of how to involve students in planning the EOC activity.
4) The developed model should also encourage teacher collaboration in planning and implementing the EOC practices.
5) We could develop some general guidelines for the teachers to plan and implement EOC activities. These same guidelines could form a basis for the quality criteria to assess the implemented EOC activities. Here are some suggestions of the possible guidelines / quality criteria:
    - The core of the project is learning
    - Objectives are derived from the curriculum
    - Objectives cover also the skills
    - Authentic phenomena at core
    - Several teachers and subjects are involved if possible, promoting interdisciplinarity
    - Students are involved in the planning, promoting co-creation or creative co-participation
    - Students' inquiry at core, teacher's role is to assist
    - Students own their work and the process
    - Collaboration is essential
    - The activities utilize EOC and versatile learning environments

2.1.3 LEARNINGS FROM HUNGARY

Age Range: 12 to 15 years old

During the co-creational session, BB talked to Sándor Koszecz (10 years of teaching experience in public schools), head of the Kollabor Science Experience Centre, about the opportunities and challenges of out-of-school education, with a specific focus on the 12-15 age group. The non-profit association provides various activities (study groups, trainings, workshops, summer camps, etc.) related to experiential pedagogy, experiential learning and innovation for young people in the city of Békéscsaba and its surroundings.
Extra-curricular activities are organized on the following themes:

- Move / Explore balance: Exploring and developing the relationships between movement and the nervous system. Scientific acknowledgment of experiential knowledge through biofeedback tools.

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- Get to know your brain: Games for improving the use of attention and stress management. Measuring effectiveness of the method with neurofeedback devices.
- World cuisine: Learning the importance of healthy nutrition and the context of food industry through interesting gastronomic experiences.
- Do It Yourself – Product development – 3D printing: In our workshop, a mentored environment allows you to create various items from idea to realization.
- Revolution of Industry 4.0: Experiencing and understanding future technological changes. Tests for improving the efficiency of machines by combining information technology and automation.
- Smart City: What will the city of the future be like? Mapping opportunities through planning and implementation projects. (How does a smart city work?)
- Robot building: Robot design and building. Automation, operation of autonomous systems.
- Autonomous vehicles: Constructing self-driving vehicles, learning the limitations and possibilities of sensors and decision-making machines.
- Planning experience tourism: Mapping of our natural and cultural values by digital means, organizing experience tourism events.

They focus on creating an inspiring learning environment where is no performance pressure. Mistakes are welcome since children can learn the most by making mistakes. They change the learning attitude with the help of learning/teaching by exploring and thus develop the internal motivation that encourages greater performance even without external performance pressure.

Three main key points were set up to keep in mind when organizing an extracurricular activity:
1. Practice is more important than theory: it is much easier to capture the **attention** and interest of children if you organize a session for them that builds on practical life experience.
2. There should be no pressure to perform: first of all, children's **intrinsic motivation** must be developed, and once this is in place, **they will want to perform**.
3. creating a culture of failure: children need to learn that failure is not a bad thing to be avoided. Mistakes should not just be suffered passively but should be considered as a source of resources and of learning. If we can develop such an attitude in students, then making **mistakes can be a tool for exploration**.

In the case of extracurricular activities, it is worth working with the agile methodology, drawing inspiration from the work of different organizations. The idea is that:
- a detailed plan should only be planned for a period of time during which the deviation from that will not be significant,
- teams are self-organized,
- everyone works at the same time (no 'supervisors'),
- there is regular evaluation of performance and frequent feedback.

He cited the Norwegian Ringstabekk Skole (for 13-16 year-olds) as an example, where subjects have been canceled and teachers group students around themes/projects which integrate the different disciplines (storyline method). Through simulation challenges, teachers try to ensure that students do not lose their innate curiosity and playfulness, as play is the

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best tool for education. Not only the students but the teachers also work in close collaboration to develop and give content to a topic or to select the students who will form a group.

He recommends planning a minimum of 5 sessions/days for out-of-school activity. Children still bring the " world of the school " with themselves during the first day. Their attitude changes slowly, no longer the teacher who tells them what to do, but the task/activity. This point everything starts to change motivation, cooperation - they get into a kind of "flow". During these sessions, it is not only the teacher who teaches, but also the children from each other, for example, the older pupils teaching the younger ones. The children figure out a project they want to work on and write a research plan. Therefore, they are more motivated and engaged. Learning becomes a real experience and not a compulsory action.
For 12–15-year-olds, it takes at least 2-6 hours to develop a workshop buzz.

Challenges
One of the challenges in organizing out of school activities is the lack of time and financial resources. But perhaps even more challenging is to convince teachers who are totally reluctant to organize extracurricular activities.

2.1.4 LEARNINGS FROM SPAIN

Age Range: 16 to 18 years old

TBVT interviewed two teachers in two separate interviews:

- Ester Martínez, from Institut Moises Broggi, in Barcelona. Teacher of Biology with students from 14 to 16 years old.
- Eloina García, from Institut Caterina Albert, in Barcelona. Teacher of Arts with students from 14 to 16 years old.

The main conclusions obtained during the interviews are:

- The EOC activity should deal with topics that fit with the scholar curriculum.

EOC activities are chosen in which a company/NGO/Museum already set up a pedagogical activity and they offer it to educational centers.

- It is better to make steps 1 and 2 something unique, together, since EOC activities are normally chosen to activities already set up, or to activities that are offered to the centers.

- Each teacher works independently and there is usually no collaboration between different subjects.

- There is no reflection by teachers about the pedagogical objectives to be faced during the EOC activities.

- Decisions about EOC activities must be accepted by the school council.

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- About including the students in the design of the EOC activities, and even in their choice, it could be, but it should be done in class, and it would take a long time.

Pre-Learning is a great time to work on values such as civility. Students must behave as a good citizen, give up seats on public transport, realize that they are representing the educational institution, etc.

Attention to diversity must be taken into account. Different types of students will experience EOC activities differently.

Post-learning can also be used to assess students. It will be important to let them know in pre-learning that they will have this evaluation. It will be important to promote teamwork. Promote EOC activities that take place during school hours to avoid absenteeism.

Teachers should be compensated for the extra hours involved in preparing an EOC activity and the extra hours involved in design and implementing it. For example, by merit recognition.

2.1.5 GENERAL CONCLUSIONS FROM THE COUNTRY LEARNINGS

- The EOC activity should serve to raise awareness to develop a project that can transform the school or the community. This will give real meaning to the EOC activity.

- The skills and competences should be work transversally during the OTTER lab.

- A research-based approach should become part of the OTTER Lab experience.

- For meaningful learning, students should be guided on a journey that introduces them to a new contextual experience which begins with ‘place’ as the starting point. One key feature is that learners analyze their experience by reflecting, evaluating and reconstructing to draw meaning in light of prior experience.

- We need to find ways to facilitate teamwork, with teachers (various teachers working together in the OTTER lab) and students.

- The pedagogical objectives, skills and competences should be part of the curriculum.

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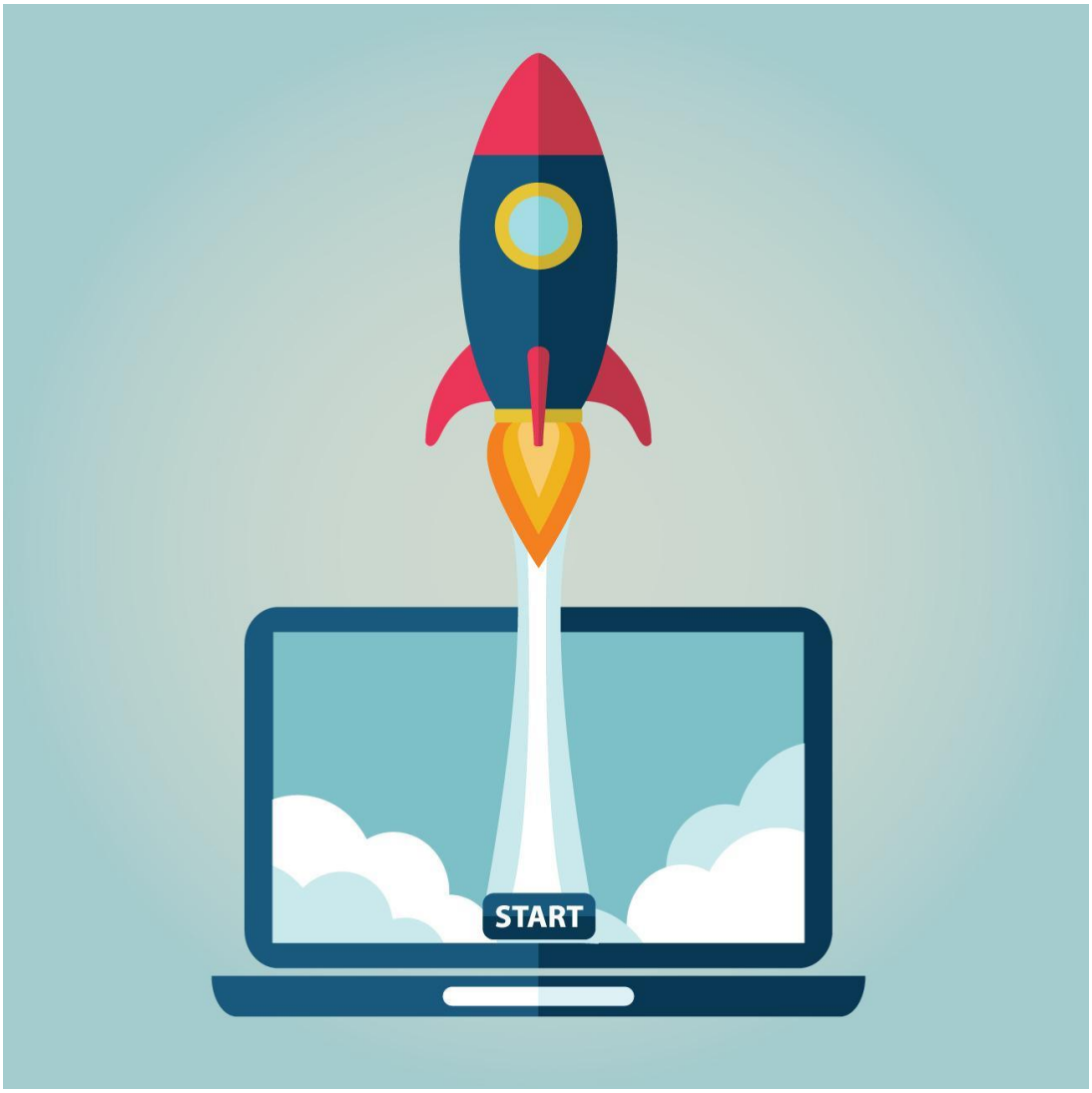
3. REFINED METHODOLOGICAL PROTOCOL ADAPTED TO DIFFERENT AGE RANGES



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3.1 Methodology to design and implement an OTTER Lab

Through this methodology, through an outdoor activity (Education Outside the Classroom activity or EOC activity) we will enable students and teachers to use the *Design Thinking* methodology to face environmental and sustainability problems, at the same time that we raise awareness on climate change and health from a scientific perspective. The compendium of all steps and stages presented in this methodology is called **OTTER Lab.**
When implementing an OTTER Lab in an educational context, we will increase the climate change awareness and create a project that will produce shifts in the current lifestyle towards a more sustainable one. It means that the OTTER Lab will generate a youth initiative (in the context of a classroom, school or community) to promote a more sustainable planet.
The OTTER Labs are developed to be adaptable to a wide age-range: between 6 to 18, from school children to college students, and the protocol designed will have to accommodate all of them. Thus, we present **one final methodological protocol with adaptations divided to fit 4 age groups**:

- from 6 to 8 (Adventurers);
- from 9 to 11 (Explorers);
- from 12 to 15 (Creators);
- and from 16 to 18 (Changemakers).

Depending on the age range, the youth initiative in the OTTER Lab may have different scopes:

- The classroom: the youth initiative will be included at the level of the students taking part in the OTTER Lab.
- The educational center: the youth initiative will transform reality at the level of the entire center, also involving students and teachers who have not participated directly in the OTTER Lab.
- The educational community: the youth initiative will go beyond the walls of the educational space? and will also be able to impact the local community.

To design and implement an OTTER Lab, teachers will carry out preliminary design and preparation work in three steps (**Teachers previous set-up**):

STEP 1 - What do we learn: Boost students' knowledge and attitude
STEP 2 - Where do we go: Define Education Outside the Classroom Activity
STEP 3 - What for: Facing environmental issues

Once completed, the second part of the educational process will begin, in which the students will work on a **Youth initiative** through 4 different stages, such as:

STAGE 1. PRE- LEARNING: Observe and Inquire.
STAGE 2. EOC ACTIVITY: Discover.
STAGE 3. THE YOUTH INITIATIVE: Energize.
STAGE 4. POST-LEARNING: Reflect and self-assessment.

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3.2 Teachers' previous set-up

STEP 1 - What do we learn: Prepare to boost students' knowledge, skills, competences, and attitude

To facilitate the inclusion of an OTTER Lab in the normal operation of the educational center, we need to think carefully about the curriculum and how the OTTER Lab can fit the pedagogical objectives included. In this way, teachers will not feel they are spending school time for an extracurricular activity. Thus, teachers must first **establish the curricular pedagogical objectives** they want to address and the skills and competencies that they want to focus on.

The optimal scenario is to work transdisciplinary; it means, teachers of various subjects work together on:

- key concepts of the educational curriculum
- academic skills and
- educational skills (Transversal skills, 21st century skills & Life skills).

There are connections between competencies, skills, core concepts and learning experiences:

- Competencies are the capacities people need to navigate their culture, community and careers. These are gained by learning skills.
- Skills are gained through the applied understanding of concepts.
- Concepts are the elements of understanding that build skills.
- Competency-based learning experiences are the driving force for the development of all competencies, skills, and core concepts. **This is the goal of our methodology.**

Depending on the age of students, we will address some educational objectives or others. The teachers, depending on the age of the students and the subjects they want to work on, will define the pedagogical objectives to address.

EXAMPLE:

Let's imagine teachers are working on an OTTER Lab with Creators (12 to 15 years).
Let's imagine two teachers of two different subjects are working together, History and Biology, to talk about the industrial revolution and the marine ecosystems.
In this context, the pedagogical objectives to be addressed could be:

a. taking care of the equilibrium of marine ecosystems.
b. Defining the main steps of the process of plastics to become waste and its effects on marine ecosystems.
c. Giving examples of social transformations caused by the industrial revolution.
d. Incorporate social skills like:
    i. collaboration,

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ii. teamwork abilities,
iii. tolerance.

e. Develop competencies like:
i. Explaining/comparing different viewpoints,
ii. creativity,
iii. critical thinking,
iv. problem solving.

STEP 2 - Where do we go: Define the Education Outside the Classroom (EOC) Activity

In this section we will think on the EOC activity to be implemented in the OTTER Lab. A good option is to work with local entities and companies that offer educational activities already adapted to the ages we work with. For primary school students, teachers should have one or several options to present to the pupils. For older ages, teachers can co-create the EOC activity with the students but, in any case, it will be crucial to have a list of possible places to visit according to the pedagogical objectives, even if they only serve as an example for the students.

Thus, we can check if the local science museum offers workshops or guided tours, and what they are about. We can look for NGOs or non-profit entities that offer educational activities or even unique companies or facilities, such as treatment plants or renewable energy production centers, which offer guided tours on their facilities. We can look for natural spaces such as large parks and gardens, botanical museums, guided excursions to forests or mountains, visits to rivers, lakes, or beaches, etc.

The most important thing is that we look for and choose an EOC activity that allows us to work on the pedagogical objectives that we have defined in step 1. Thus, it will be the task of the teacher to find the connections between the EOC activity and the curricular objectives defined in step 1 and generate pedagogical approaches that allow students to learn more deeply, making the most of the EOC activity.

EXAMPLE

Let us continue with our group of Creators in the OTTER Lab, working on the 2nd industrial revolution and marine ecosystems.
A possible EOC activity that can be carried out is to visit a company that uses plastic waste obtained from the selective collection of urban waste as raw material for quality plastics for 3D printers.
With this EOC activity, students will be able to understand the industrial development that has occurred since the 2nd industrial revolution until now, realizing about the challenges we have now in the use of plastics. They will understand the life cycle of plastics, realizing that if plastics are selectively separated at home, they have a new useful life, but if not separated correctly, they end up becoming waste. Students will see the magnitude of the problem of plastic waste, as they will work with large amounts of plastic waste that is produced.

STEP 3: - What for: Facing environmental issues

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In this step, we will find a practical application to face environmental issues. Thus, teachers should think about the plausible connections between what has been developed in steps 1 and 2, and real environmental problems. In this sense, teachers will create the need to understand and incorporate the pedagogical objectives that are being worked on, as well as the importance of getting the most out of the EOC activity.

EXAMPLE

In the case of the OTTER Lab on the 2nd industrial revolution and marine ecosystems implemented with Creators, an environmental problem related to the pedagogical objectives defined in step 1 and the output defined in step 2 could be:
The effect of plastics on marine ecosystems.

If the plastic objects that we use in our daily lives (plastic bottles, food containers, etc.) are not selectively separated and reused, they can end up in rivers, seas and oceans.

Plastics in the oceans are ingested by living beings such as birds, fish, seals, turtles, whales, etc., interfering with their digestive system and even causing death.

Furthermore, the plastics in the oceans degrade, giving rise to microplastics, which are ingested by marine animals and even us, humans. Microplastics have already been found inside the body of human beings, and we do not know what harmful effects this may have on our health.

Thus, the conversion of plastics obtained from solid urban waste into materials for 3D printers allows these plastics to be put to a new use, activating the circular economy, and thus avoiding the problems that these materials generate if they end up as waste in seas and oceans.

NOTE: *These 3 steps are shown as a work methodology, but they are not needed to be followed in the order presented here. In other words, if an educational center has the possibility of carrying out an EOC activity that is of great interest, this can be the starting point for organizing the OTTER Lab. It will be from the EOC Activity that we will define the curricular pedagogical objectives that best suited to the output and the environmental issues to be addressed. The order in which we apply these three steps will not alter the final product.*

3.3 Students & teachers' joint action: THE OUTDOOR ACTIVITY AND THE YOUTH INITIATIVE

Once steps 1, 2 and 3 have been defined, teachers and students will work together in an educational process in four STAGES:

STAGE 1. PRE- LEARNING: Observe and Inquire.
STAGE 2. EOC ACTIVITY: Discover.

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STAGE 3. THE YOUTH INITIATIVE: Energize.
STAGE 4. POST-LEARNING: Reflect and self-assessment.

Through these 4 stages, the students will carry out the EOC activity that serves as a starting point for the design of a transformative project capable of facing the environmental problem defined by the teaching staff, what we have called: THE YOUTH INITIATIVE.

With this YOUTH INITIATIVE, the students realize the need to incorporate the pedagogical objectives to have the tools to solve an environmental challenge. In addition, they understand the reasons why the EOC activity has been carried out and realize that everything learned during that outing is useful to face environmental problems. While students are carrying out the youth initiative, they train and practice skills and competences to become active agents of change and to act as ambassadors that raise awareness among the people around them.

STAGE 1. PRE-LEARNING: Observe and Inquire.

Students will take part in pre-learning activities, facilitated by teachers or local experts in environmental sciences inside the classroom, which will serve as an introduction for the topic related to the EOC activity.

In this stage we will inform the students that we are going to carry out an EOC activity, and we will inform them of the place we are going to visit. We will also give the students the key knowledge of the curriculum that we have defined in STEP 1, and we will work in the classroom on the necessary skills and competences so that the students behave in a civil and correct way outside the classroom. We will also explain to students the environmental problem defined in STEP 3, as well as its relationship with the EOC activity.

Finally, we will explain to the students that, once the EOC activity has been completed, they must design and implement a Youth Initiative that can deal with the environmental problem defined in STEP 3. At this point, the students must understand that during the EOC activity they will learn a series of data, concepts and methodologies that will be necessary to develop a Youth Initiative capable of improving the planet in general and their lives.

EXAMPLE:

In the case of the OTTER Lab with Creators on the 2nd industrial revolution and marine ecosystems, at this point the History teacher can invest one or two of his classes (or those he considers necessary) to explain the 2nd industrial revolution, relating the role of oil and plastics with social transformations, and connecting this knowledge with the EOC activity that will be carried out at the plastic production plant for 3D printers from plastic waste obtained from the selective collection of urban waste.

The biology teacher can relate the EOC activity with the presence of plastics in the oceans and its effects on marine ecosystems.

The students could also search for the information they need themselves, facilitated by the teacher.

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Finally, one of the teachers involved in the OTTER Lab will dedicate one of their classes to explain the students that, once they have visited the plastics factory for 3D printers, students will have to imagine and generate a Youth Initiative to face the problem of the presence of plastics in the ocean and its interference in marine ecosystems.

NOTE: In this stage of the project, it is possible that the students take ownership of the project and decide that they want to face an environmental problem different from the one previously identified by the teachers. If so, we must allow the students to make that change. Let's give students the tools to develop their own ideas, let them fly their imagination, their creativity and their critical capacity for problem solving.

STAGE 2. EOC ACTIVITY: Discover

Students will take part in a tour of a place, i.e., de EOC activity defined in STEP 2, like a company or organization that are carrying out a task which contributes towards sustainability. It can be done/realized by reducing plastic waste, which could be recycling plants, factories using sustainable methods/materials or a university developing new biodegradable materials which can be used as an alternative to plastics. In less industrialized areas this could include visits to more local projects such as organizations involved in cleaning in the community and NGOs working to preserve green spaces in cities. In this way, students will get in touch with the real-life issues concerning plastic waste and will get familiar with different ways of coping with this issue. Authentic, hands-on environments enable simulated experiences to occur. Students experience the emotions and senses attached to real-life scenarios, cultivating understanding, empathy, healthy habits with them and the environment, and confidence.

For this phase, it will be important that the teaching staff, in collaboration with the entity that organizes the outing, have prepared a whole series of data, activities, workshops, reflections, debates or any other pedagogical activity that allows students to transmit relevant information in relation to the environmental problem that has been defined in STEP 3 and that has been previously worked on in the classroom in STAGE 1.
When the EOC Activity is carried out, the students will participate in these pedagogical actions being aware that everything they are living, experiencing, and learning they will need to create and implement the Youth Initiative, within which they will be more motivated and will understand why is doing this activity.

EXAMPLE:

For the OTTER Lab with Creators at the plastics factory for 3D printers, some of the possible activities to be carried out and the data to be transmitted to the students could be:

- Plastic waste reusing workshop, so that it can be used as raw material for other purposes. The students themselves receive a mountain of plastics of different types, all mixed, and must separate them by type, to use them in the process of producing plastics for 3D printers.
  In this workshop, students can find data related to the number of plastics that are produced in their local area, the % of those plastics that are selectively separated, and therefore, the number of plastics that end up as waste in landfills, seas and oceans.
- 3D printed furniture workshop with recycled plastic. Students can use

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	computer design programs to design small gadgets that they will then print on the spot. At this point, students can research how much plastic is used in the world that ends up becoming a dangerous waste for marine life.

STAGE 3. YOUTH INITIATIVE: Energize

The OTTER labs should include a stage in which students and teachers design a youth initiative, which is a hands-on project to face the environmental issue identified in STEP 3 and analyzed in Step 1 (to reduce plastic waste or to enforce the environmental health in the local area). Thus, the EOC activity serves as an awareness raising activity to create a real project to find solutions for real environmental issues.

For places near the sea, this could include beach clean-ups or participating in other local marine waste initiatives, while locations in-land could include tree planting, up-cycling workshops or even a hiking trip to clean up the local natural environment. For schools with schedule restrictions or for younger ages, this can include initiatives inside their own school. The pedagogical goal of this approach is to promote the common efforts for sustainable economy and to appreciate the advantages of a clear and less polluted environment.

We propose to use **DESIGN THINKING** to ideate, compose, generate ideas, and implement the *Energize stage,* i.e., the Youth Initiative. Design thinking is an iterative process that provides a solution-based approach to solving problems, in this case, environmental problems. Using a structured framework, students identify environmental challenges, gather information, generate potential solutions, refine ideas, and test solutions. According to the learnings collected in this deliverable, we consider this is the best approach to follow as it connects real world problem-solving with classroom environments. Teachers and students engage in hands-on design challenges that focus on:

- developing empathy with “the users” (in this case, people living in this planet)
- promoting action against environmental problems
- encouraging ideation of possible solutions
- developing metacognitive awareness
- fostering active problem solving.

Throughout this iterative process students are encouraged to understand we, the people, as planet users, challenge assumptions, and redefine sustainability problems.

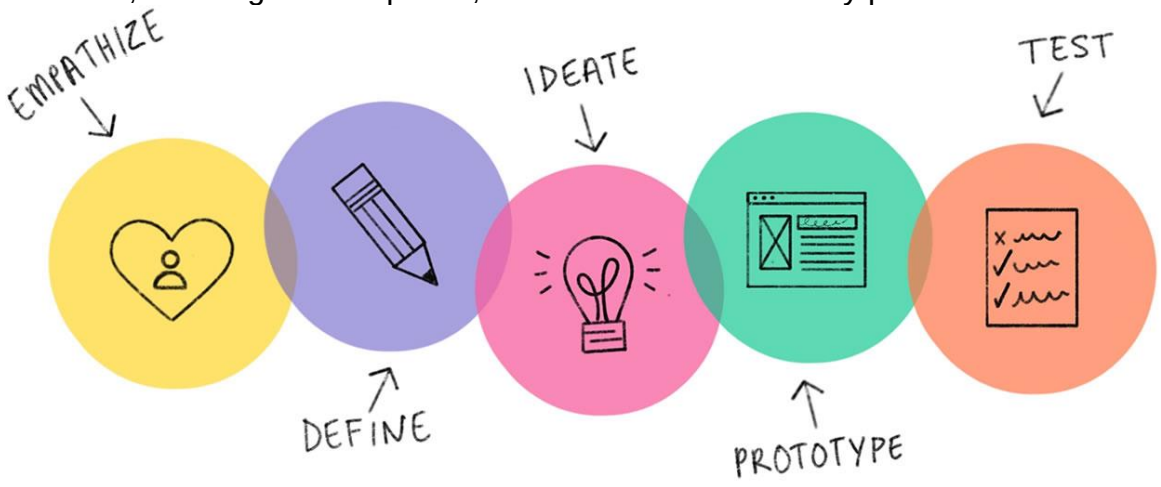

Figure 2: Design thinking steps

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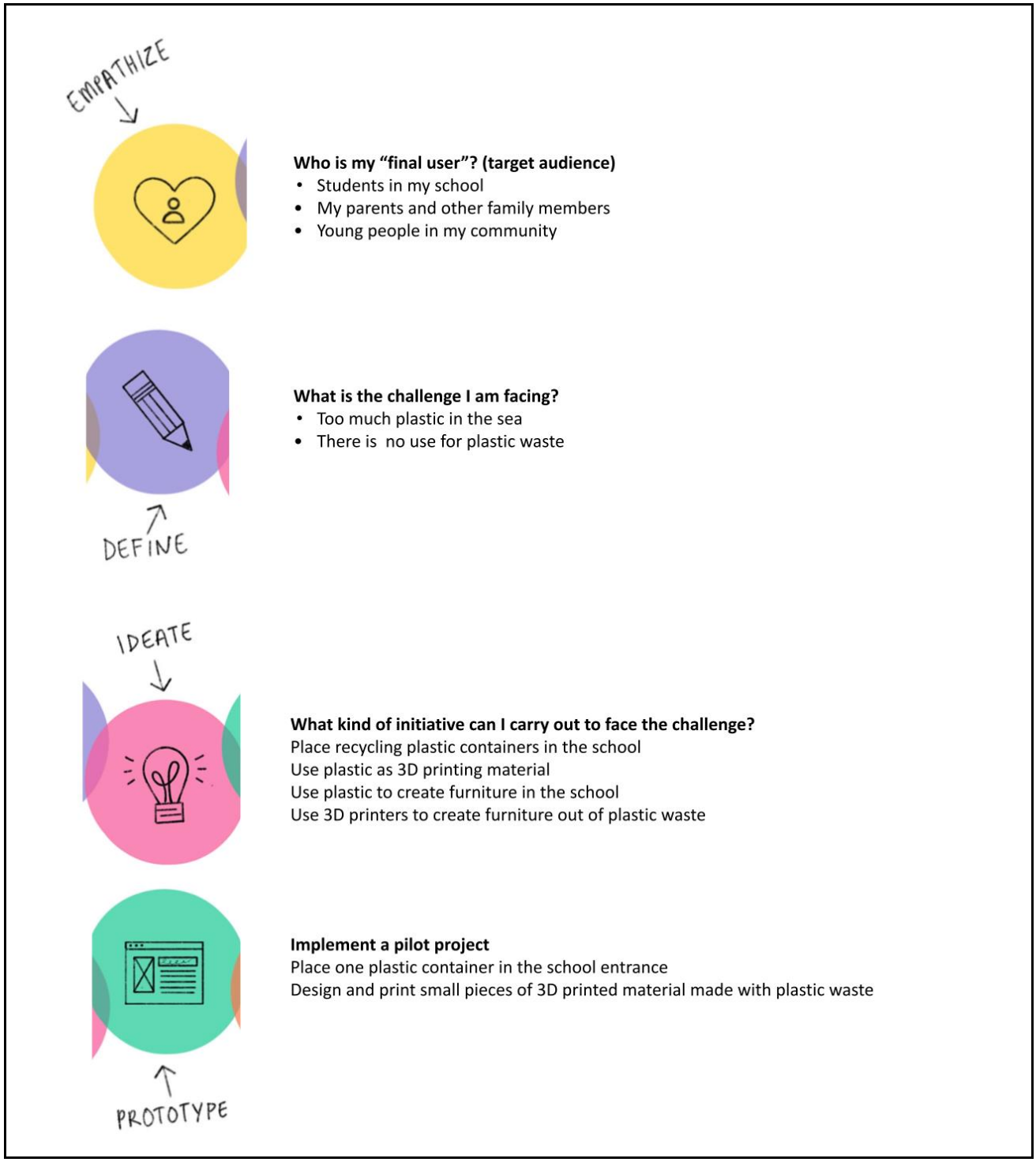
At the core of OTTER Lab is the intention to make the students aware of their own behavior and impact on the environment, locally and globally. The final goal is to foster solutions for sustainability issues by analyzing and understanding how users (people) interact with the planet and investigating why (what are the drivers) to operate like this. This involves asking questions and challenging assumptions. Once students have questioned and investigated the conditions of a problem, the solution-generation process will help produce ideas that reflect the constraints and barriers of that problem.

EXAMPLE



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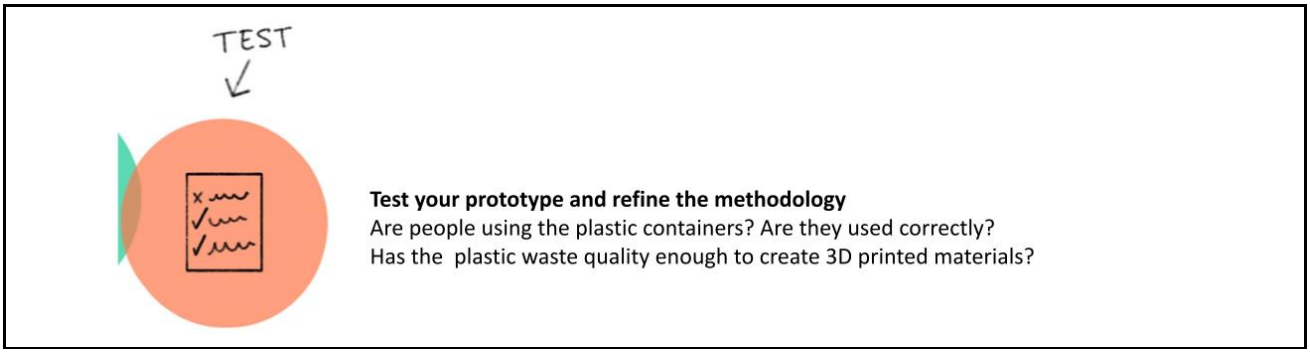

STAGE 4. POST-LEARNING: Reflection and self-assessment

The students will now be encouraged to reflect on the previous activities, participating in a session for questions and open debate with their teachers and any experts from the previous activities who might be able to join. Reflection is about students becoming aware of their own thinking processes and being able to make those transparent to others. It enables assessment of the "why" and "how" of the learning, and what needs to be done as a result. Reflection readily follows on from self or peer assessment.
When students and teachers routinely reflect, they will be able to easily describe:

- what have they learned
- what has been intended to be learnt
- why is that important
- how learning is connected to their real life
- where they will go next.

The objective of this stage is to prepare students to continue acting for the environment and to put into practice concrete activities and lessons learnt to raise awareness among them about these environmental issues.

3.4 METHODOLOGICAL ADAPTATIONS TO THE AGE-RANGE

ADVENTURERS (6-9)

According to the learning during task 3.1, one of the goals in this age is to encourage students to be playful, curious, creative, and eager to experiment and explore the world that surrounds them. Learners begin to understand their surroundings and how their behavior has an impact on the environment. They start to develop awareness through personal responsibility.

PRELEARNING AND DISCOVER

The learning goals, concepts, and the place to visit should be selected by the teachers and they can also be voted by the students. Ideally, the outdoor activity should include time to play and collaborate with others.

ENERGIZE (Youth initiative)

Teachers explain to the students what design thinking is and the basic steps. At this age, projects should enable students to know more about their environment, surroundings, and

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human impact (their own impact). It Is not necessary that projects have a big impact on their local area but should be something to raise awareness of students about the necessity of taking action.

POSTLEARNING

The post learning will include a self-assessment of the learned new topics, a reflection of the whole learning process, analyzing what has been learned and what we still want to learn.

EXPLORERS (9-12)

According to the learning, students in this age start to understand themselves and the world at a deeper level. They are naturally curious and see learning outside the classroom as a fun way to learn. They enjoy creativity and new ideas.

PRELEARNING AND DISCOVER

Teachers can propose some learning goals and students can select what they are interested in. If the teacher already has the objectives and contents chosen, the students can suggest suitable locations. Thus, the activity can be co-designed between teachers and students but, at this age, teachers should have clear pedagogical objectives that are based on the curriculum.

ENERGIZE (Youth initiative)

Teachers explain to the students what design thinking is and the basic steps. At this age, projects should enable students to know more about their environment, surroundings and human impact (their own impact). Projects can be something to transform their local reality through deep understanding.

POSTLEARNING

The post learning will include self-assessment of the learned new topics, a reflection of the whole learning process, analyzing what has been learned and what we still want to learn, setting new learning goals for the future, etc.

CREATORS (12-15)

At this age, students start to be self-directed learners who can propose solutions and create local projects to mitigate sustainability issues in their communities. The goal is to promote a focus that expands their understanding of how they might contribute solutions to complex global challenges.

PRELEARNING AND DISCOVER

Students participate actively in the activity design, concepts to tackle and environmental problems to face.
Students should reflect about their previous knowledge and what they need to learn more in depth to carry out the Energize stage.
Students define what they want to learn and to analyze in the Energize activity.

ENERGIZE (Youth initiative)

Students decide what kind of transformative project they want to develop, according to their interests and skills. To do that, active research should be carried out to understand the

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problem they are facing, the end users of their project and drivers that potentially will move people to join the project.
The project ideally should go beyond the classroom and incorporate, at least, the rest of the school/ educational community.
They will incorporate the design thinking model, so the project has to be prototyped and tested.

POST LEARNING

Post- learning will incorporate a self-assessment and a reflection about what they have learned, how these learnings are beneficial to them and to others. The post learning should also include the final conclusions and learnings from the prototype tested in the Energize stage.

CHANGEMAKERS (15-18)

In their last years of high school, according to the learning, students should develop growing understanding and knowledge to tackle environmental challenges that will have a severe impact on their near future. The idea is to intentionally interact with a range of professionals through multidisciplinary projects.

PRELEARNING AND DISCOVER

Students should design the outdoor activity, according to the pedagogical objectives, their interests and their passions. The activity should be designed in a way that can lead to a project (Energize) that students want to implement in their community.
Students should reflect about their previous knowledge and what they need to learn more in depth to carry out the Energize stage.

ENERGIZE (Youth initiative)

Students decide what kind of transformative project they want to develop, according to their interests and skills. To do that, active research should be carried out to understand the problem they are facing, what other associations, NGOs, civil groups and experts are doing to tackle the problem and how they can participate/ improve the.
The project ideally should go beyond the school and involve their local area/ neighborhood.

POST-LEARNING

Post- learning will incorporate a self-assessment and a reflection about what they have learned, how these learnings are beneficial to them and to others. The post learning should also include the final conclusions and learnings from the prototype tested in the Energize stage and future steps to refine it.

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